Reg. U. S. Pat. Off.

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JANUARY—1950

No. 163

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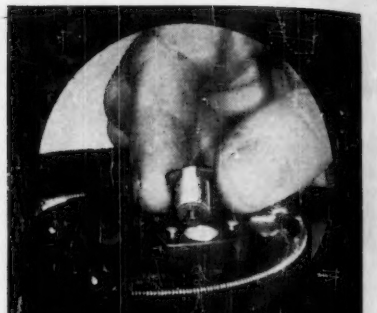

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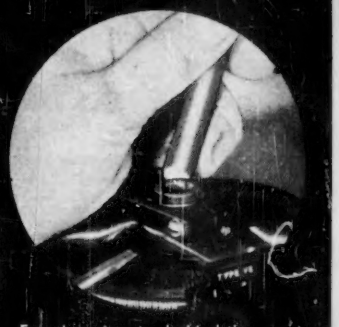

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ASTM BULLETIN

"Promotion of Knowledge of Materials of Engineering, and Standardization of Specifications and Methods of Testing"

TELEPHONE—Rittenhouse 6-5315

R. E. Hess, Editor
R. J. Painter, Associate Editor

CABLE ADDRESS—TESTING, Philadelphia

Number 163 JANUARY, 1950

Many Notable Accomplishments by A.S.T.M. During 1949

Highlights of the Year Include Several New Technical Committees, Extensive Publications, and the First Pacific Area National Meeting

BECAUSE of the great diversity of the Society's work, cutting across virtually every major materials field, it is difficult and, in fact, almost impossible to present any readable type of review article. Yet it is very desirable that some kind of discussion be presented which at least gives the high lights of the major things A.S.T.M. has accomplished. That is specifically the purpose of the material which follows.

It is a review article only in the sense that it is selected from our major accomplishments. It does not attempt to indicate any particular trends or activities and most certainly is not a preview of what 1950 has in store, and some of these will be noted in the January 1951 BULLETIN!

Organization of New Technical Committees.—While many of the longer established technical committees have made major strides in various phases of the work as noted below, probably the organization of new technical committees should be considered the chief high light of 1949.

Much consideration, time, and effort —a great deal more than is normally realized—is devoted to a new technical group. Consideration of new committee organization always raises important questions. First is there a real demand from those concerned for standardization and research activities? And even before that, does the work logically lie in the scope of the Society? Will there be a good support of the work on the part of both the users and consumers if A.S.T.M. undertakes the project, thus insuring that some constructive results will be forthcoming? What are the main channels of activity? Finally, who are the logical technical authorities to participate in and guide the work?

There are many other questions involved in establishing each new technical group. These are not problems that are publicized, but might be kept in mind when noting below the technical committees that have come into being in 1949.

Technical Publications.—Members are kept fully posted on the Society's extensive publication ventures. Each issue of the BULLETIN describes the new books that have been issued, including technical symposiums and special books as well as the compilations of standards and the main Book of Standards. It is becoming common and almost trite to announce that each year's publication schedule is the heaviest the Society has had. And with the greater volume of material it becomes accordingly more difficult to cite those things which are outstanding because each publication is carefully considered and not undertaken unless it appears to offer information and data of value. However, because of the significance and importance of several symposiums and publications of 1949 they are referred to in what follows.

National Meetings.—The annual meeting of the Society in June is always a high point in A.S.T.M.'s affairs and 1949 was no exception. However, there was something unusual on the national meeting stage last year: namely, the first Pacific Area National Meeting held in San Francisco, October 10 to 14. Due to the combined efforts of the general committee on arrangements and its subcommittees, the authors of the many technical papers, and also the technical committees participating, this was an outstanding affair. A rather detailed news account appeared in the December BULLETIN. A number of the technical symposiums are to be published.

Arrangement and Conclusion

An attempt is made in the descriptive material following to arrange it in general order of the technical committees; namely, ferrous metals, followed by non-ferrous metals, cementitious, ceramic and related materials, and finally materials such as petroleum, paint, timber, rubber, textiles, and the like.

As in so many phases of our work there are some crossovers, but it is hoped the paragraph headings will enable members to concentrate on subjects of more specific interest.

Conclusions—It may not be good technical writing, or for that matter, good composition of any kind to note conclusions before the end of an article, yet we cannot resist noting one conclusion here. Obviously there are many which might be drawn from studying the many diversified projects in the Society. We can only conclude that as a result of the inspiring, continuing cooperation of so many of the country's leading technical men, the year 1949 was for A.S.T.M. one of outstanding work and accomplishments. The results were of unquestionable benefit to American industry and government. The year gave many notable examples of worthwhile contributions within the Society's scope of promoting the knowledge of the properties and tests of materials and standardizing specifications.

Ferrous and Non Ferrous Metals—Testing

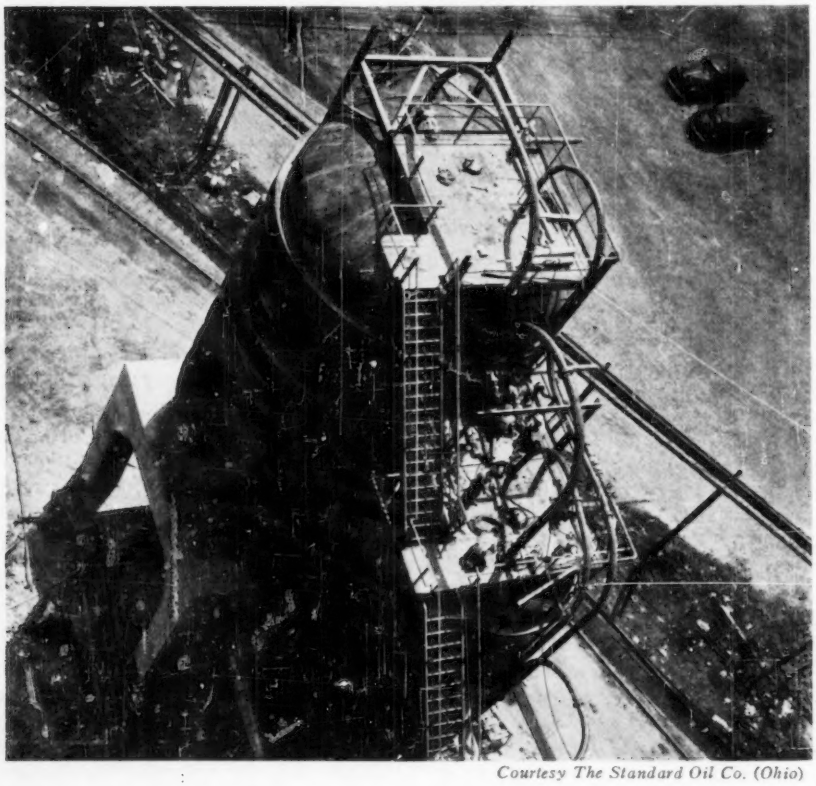
Steel and Steel Products—Especially Structural Steel and Forgings:

Unquestionably in the ramified work of Committee A-1 on Steel the outstanding accomplishments, perhaps those that are possibly of widest concern and the result of the most intensive work, include the development of the so-called "Master" specification for structural steels, with its allied product specifications, and, secondly, the extensive revisions of a large number of forging specifications.

Probably no specifications have been so widely applied as those covering structural steel, and the Standard A7 was one of the first specifications issued by A.S.T.M. some fifty years ago. Subsequently several other standards for steel for structural purposes were issued. The committee decided to group into one document (A 6–49 T) all tables or tolerances, permissible variations, and similar material common to the several product specifications, and in companion product specifications cover the essential purchase requirements such as chemical and mechanical properties, testing techniques, and the like. Thus the general specification A6 is a part, even though separate, of some ten product specifications. This move had the strong support of producers and consumers alike. Various other improvements in the specifications were incorporated. For further details, see the May, 1949 ASTM BULLETIN, page 22. This new practice in Committee A-1 is significant because it may be the forerunner of similar considerations and actions involving plates for boilers and pressure vessels, possibly tubular materials, and other groups of steel products.

Forgings.—Many months ago when revisions were being considered in certain of the specifications for steel forgings, it quickly became apparent to the committee members that detailed study should be made of all of the forging specifications, and that a major job of revision was desirable. Intensive work finally culminated in December, 1949, in the approval of major revisions, including the reversion to tentative of several of the standards. Further details are given on page 14 of this BULLETIN.

Deformed Concrete Reinforcement Bars.—The widespread use of deformed concrete reinforcement steel led Committee A-1 about two years ago to develop requirements for the Deformations of Deformed Steel Bars for Concrete Reinforcement (A 305) and this year, following some minor changes, the tentative was adopted as standard. Because of the great importance of this standard and its significance to the producer of reinforcement bars as well as to the designer and contractor, its adoption as standard may be considered an important step forward.



Courtesy The Standard Oil Co. (Ohio)

Looking Down on a Catalyst Storage Chamber. This photograph also illustrates the widespread use of varied constructional materials in industry.

Foundry Pig Iron:

The tentative specifications for foundry pig iron were last revised in 1945. The forerunner of this document is a very old standard having first been issued in 1904. The latest revisions, just approved in December on the recommendation of Committee A-3 on Cast Iron, incorporated changes to bring them in line with the latest practice, in particular the silvery irons, and also incorporated the latest system of grade designations. This latter is of considerable significance because of the large number of grades covered, there being upward of 300 of these.

Non-Destructive Testing:

One of the notable activities of Committee E-7 on Non-Destructive Testing, its scope now expanded from its former limitation to radiography, was the sponsoring of technical papers and discussions. In June, 1949, at Atlantic City, the committee arranged for two significant sessions, one with five papers on Radiography, the second, with seven papers on Ultrasonic Testing. Latest

developments in the use of radiography were covered in the first group of papers, and the purpose of the second group was to show that this type of testing has wide applicability and can aid manufacturing practices as well as furnish an important inspection tool. The papers on radiography will be published shortly, but it is not expected that those covering ultrasonic testing will soon be available.

Grain Size of Copper Alloys:

For many years the standard requirements on measuring grain size of nonferrous metals and alloys and an actual grain size chart appeared in the Standard E-2. However, through the work of Committee E-4 on Metallography which realized that the requirements were not wholly applicable, a new tentative has been issued (E 79) for estimating the average grain size of wrought copper and copper-base alloys, which applies to structures composed entirely or substantially of the alpha phase. This includes details of preparing and measuring specimens, and a new chart. It is the intention that similar requirements will be developed for other nonferrous metals.

This committee also has to its credit the new Method of Determining the Orientation of a Metal Crystal (E 82), and the Recommended Practice for Dilatometric Analysis of Metallic Materials (E 80). These are important accomplishments—details of which are given on page 14 of this BULLETIN.

Classification of Aluminum Alloys:

The designation and classification of various non-ferrous alloys are extremely important to both the consumer and producer. One of the first such classifications covering copper and copper alloys was issued several years ago, and Committee B-7 on Light Metals and Alloys during 1949 completed a significant classification which is applicable to the large number of specifications for aluminum and magnesium. While a seemingly minor matter, it affected the numerous specifications and involved somewhat of a major overhaul of these standards.

Nickel and Nickel Alloy Specifications:

As detailed elsewhere in this BULLETIN, Committee B-2 on Non-Ferrous Metals and Alloys recently completed important revisions in the group of specifications covering various types of nickel alloy products, including bars, tubing, strip, and plates. The ten specifications studied were last revised in 1941 and, as modernized and brought into line with latest practice, the specifications will undoubtedly find a wider application. Certainly to the many concerned with these products, the newly revised specifications are very significant.

Courtesy The Standard Oil Co. (Ohio)

Some of the Many types of Laboratory Apparatus Required in Testing and Research in Petroleum Products

Identifying Metals Rapidly (Spot Tests):

A notable technical symposium held at the 1949 Annual Meeting under the auspices of Committee E-3 on Methods of Chemical Analysis of Metals covered rapid methods for the identification of metals. There were eleven technical papers including the introduction. Certain of the papers described the general principles involved in various methods while others described specific applications. This symposium is in course of publication and it should be of widespread interest and service to all those concerned with the analysis of metals and alloys.

While probably the major objective of Committee E-3 is to provide analysts with recognized authoritative procedures, particularly of the referee class, for various ferrous and non-ferrous metals, the committee realizes its great responsibility in providing a forum so that newer methods and more rapid procedures can be discussed and publicized. Many of these methods may sooner or later become recognized standards. The symposium on so-called spot tests is one of the projects in this objective of the committee.

It is appropriate to note that the widely distributed volume giving A.S.-T.M. Methods of Chemical Analysis of Metals will appear in an extensively revised and amplified edition about the middle of 1950.

Effect of Temperature on Metals:

From a news article elsewhere in this BULLETIN describing the activities of the Joint Committee on Effect of Temperature on the Properties of Metals which functions under A.S.T.M.-A.S.-M.E. auspices, it will be apparent that this group has had one of its most active years. Its annual report includes results of two extensive research projects under way and also published are data on the testing facilities that are available in American laboratories. The intensive work required to develop these data are carried out in the Joint Committee's Subgroup on Data and Publications. This article is not intended to be a forecast, but those concerned with metals at elevated temperatures should by all means follow closely during the next year the work of this committee. It has one of the most extensive programs of technical activities planned of any technical committees (see page 25 for other details).

"Wetting Agent by Polarized Illumination"

First prize-winning photograph, Electron Micrograph and Photomicrographs Section, Photomicrographs Group (Plastics and Fibers), in the Sixth A.S.T.M. Photographic Exhibit, by A. F. Kirkpatrick, American Cyanamid Research Laboratory. (200X)

X-ray Diffraction Data for Identifying Crystalline Materials:

It is not the practice in the ASTM BULLETIN to make inordinate use of superlatives, but it is only by means of superlatives that one can describe aptly the stupendous amount of work involved in preparing the new Card Index File of X-ray Diffraction Data which is in course of publication by the Joint Committee on Chemical Analysis by X-ray Diffraction Methods, in which the A.S.T.M., A.S.X.R.E.D., and the British Institute of Physics are cooperating. Prof. Wheeler P. Davey at Penn State College and his staff completed in 1949 the tremendous job of revising the set of original cards aggregating about 4000 and assembling the data, classifying them, and checking and recording for reproduction the supplementary set of 4500 additional cards. Details of this very valuable project in which all those concerned with X-ray diffraction are vitally interested were given in the September ASTM BULLETIN. Further announcement will be made when both the original and the supplementary card files are available.

Manual on Fatigue Testing:

The publication of the Manual on Fatigue Testing just off-press culminates several years work by Committee E-9 on Fatigue. This has been a major project of the committee since 1946 and it is felt the publication will be of great value and interest to all concerned. Leading authorities represented on the committee have prepared the various sections and the whole has been reviewed by the committee, so that the final publication really represents the composite ideas and experience of many of the country's leading experts in this field. Primarily the manual covers fatigue testing and not fatigue of metals as such. The object of the manual is to give pertinent information to those setting up new laboratory facilities, to help in operating the testing equipment properly, and to give information on the best methods of presenting and interpreting the data.

Data on Corrosion and Heat-Resistant Steels—Both Wrought and Cast:

The long-awaited compilation of data on the compositions and properties of corrosion and heat-resistant steels and alloys, both wrought and cast, is virtually off-press, and represents the results of a tremendous amount of work in Committee A-10 on Iron-Chromium-Nickel and Related Alloys. While some of the data on wrought materials were issued a few years ago, the data on cast alloys have not previously been included. Stainless steels that have the widest commercial usage are covered. The data have been condensed to the simplest form so that it would be most useful for both the maker and user of steels. Where possible the alloys have been identified with appropriate A.S.T.M. specifications and as a helpful reference the A.I.S.I. type numbers for the wrought materials have been given and the A.C.I. designations for the cast alloys.

Permanent Corrosion Test Sites Established—Work Being Coordinated

Down through the years some of the Society's most important research work has involved the development of reliable data on the corrosion-resistant properties of various materials, in particular ferrous and non-ferrous metals and alloys. Some of the test programs have been under way for many years, notably the tests on steel sheets at Annapolis which have been under way for over thirty years. It has been apparent for some time that with different technical committees using various test sites, and the possibility of some overlapping in the work, that coordination of the atmospheric and other types of exposure tests carried out in the Society would be desirable; and perhaps of paramount importance that permanent test sites be established. Some of the sites that were used for a number of years had to be abandoned and in some cases programs could not be carried to completion. While detailed announcement of the plans has not yet been made, there was brief reference to the work in the 1949 Report of the Board of Directors. Meanwhile, although in considerable measure unheralded, the coordination of the work through the Advisory Committee on Corrosion and procurement by long leaves of permanent test sites has made much progress.

To give some idea of the extent of A.S.T.M. corrosion research work and the complexities of problems, at least 25 different exposure sites have been in use. This work will now be concentrated at about eight permanent locations which should provide almost any technical committee of the Society with the various types of environment that might be required.

March 15 Last Day for Pacific Area Meeting Papers Discussion

MUCH of the discussion of technical papers and reports published in the *Proceedings* and other publications is submitted after the actual presentation of the papers or reports "by letter".

Written discussion of papers presented at the First Pacific Area National Meeting, held at San Francisco in September, 1949, will be received by the Committee on Papers and Publication until March 15. It will be greatly appreciated if all who plan to submit such discussion will do so well in advance of this date so that additional time is available for review and submission to authors for closure.

Ceramic Materials and Materials Generally Used for Construction Purposes

Chemical Resistant Mortars:

The organization of a new technical committee on chemical resistant mortar was accomplished in October. Growing interest in these materials and the desirability of sponsoring needed research and particularly of establishing standard requirements and testing procedures led to the decision to assign work in this field to a separate committee rather than continue it as a subcommittee in one of the other technical groups. A variety of mortars will be included in the work including silicates, resins, sulfurs, hydraulic cements, and several miscellaneous types.

Ceramic Materials, Whitewares, Porcelain Enamel:

With the organization of the new technical Committee C-21 on Ceramic Whitewares (details in the March, 1949 BULLETIN), and the new Committee C-22 on Porcelain Enamel, A.S.T.M. has quite a group of committees working in the field of ceramics. Committee C-8 on Refractories, the Committee on Drain Tile, and much of the work of Committee C-15 on Manufactured Masonry Units are also in this field.

The organization of Committees C-21 and C-22 is a notable accomplishment of 1949. The group on ceramic whitewares are concerned with such materials as sanitary ware, electrical porcelain, chemical porcelain, stoneware, ceramic tile, dinnerware, etc. This group is working very closely with the Whitewares Division of The American Ceramic Society.

Wider applications of porcelain enamel and porcelain enamel products and the desirability of agreeing on specific definitions of terms, establishing standard testing procedures and specifications, led to the establishment of Committee C-22. The work includes coating for metals. Again as is the policy in so many A.S.T.M. technical projects this work will be coordinated with the work of the Porcelain Enamel Institute and with the Enamel Division of The American Ceramic Society. The list of personnel was given in the September BULLETIN.

Acoustical Materials:

Another new technical committee formally organized during the year and which has held a series of technical meetings, covers the field of acoustical materials, the committee designation being C-20. Materials to be covered in the research and standards work include those primarily used to absorb airborne sound. A news account of the committee's first technical meeting on November 15 in St. Louis appears on page 26 of this BULLETIN. This meeting was held just before the fall meeting of the Acoustical Society of America. Some of the problems under study in various subcommittees involve sound absorption, fire resistance, maintenance, applications, and physical properties.

Pozzolans:

While we should hesitate to indicate that any technical symposium at Society meetings during the year was predominant above any other in interest, there is no question that the interest in the symposium on pozzolanic materials in mortars and concretes held during the Pacific Area National Meeting was very great, as amply demonstrated by the number of papers and the excellent attendance at the symposium. The nine technical papers were duplicated and "went like hot cakes" at the meeting. It is the hope to publish this symposium later in the year.

Committee C-1 is much interested in these materials and has some technical work under way on them.

Miscellaneous Materials, Petroleum Products, Paints, Rubber, Textiles, Etc.

Printing Ink—Test Methods and Nomenclature:

A most widely used material, one without which this article would be nonexistent, is to be studied in a new technical committee organized during 1949; the material—printing ink. Leading producers and users agreed that there were numerous problems on which much constructive work might be done. In addition to standardizing of nomenclature and definitions, various testing methods for evaluating important properties are being studied.

Petroleum Products:

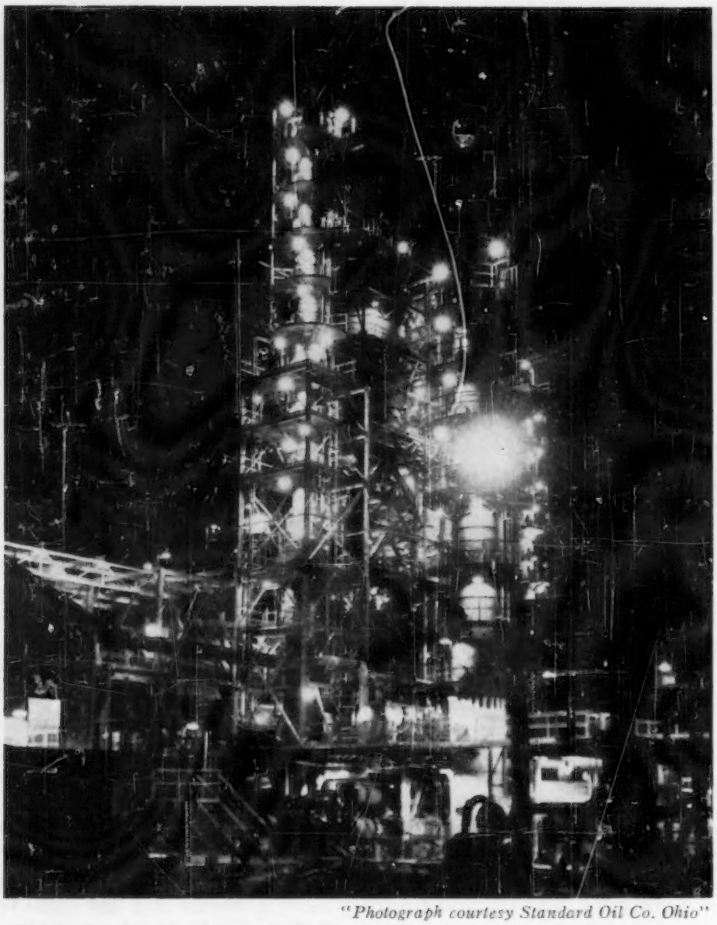
To select the outstanding accomplishments of a committee like D-2 on Petroleum Products and Lubricants which developed several interesting and worth-while technical symposiums and sessions during the year, which had an Annual Report that was virtually a book in itself, and has during the year completed reorganization of its widespread activities, is, to put it mildly, difficult.

Standards on Petroleum Products:

During 1949, Committee D-2 not only acted to keep its large number of over 100 standards up to date, which in itself is a major task, but developed at least six proposed methods for important properties of materials that were published as information, and in addition had accepted at the Annual Meeting, twelve new tentative methods. These are included in their latest forms in the compilation of Standards on Petroleum Products and Lubricants which recently came off press. The size of this annual publication and its distribution, incidentally, is one of the pertinent indications of the activity in this field and of the interest in it.

Reorganization:

Perhaps reference might be made first to its reorganization. The committee has grown in recent years to include over 600 active technical people representing consumers and producers of petroleum products. The desirability of streamlining the committee setup and coordinating the ramified work has resulted in the appointment of a series of technical committees, such as A, Gasoline; B, Lubricating Oils; C, Turbine Oils; E, Burner Fuel Oils; F, Diesel Fuels; G, Lubricating Grease; H, Light Hydrocarbons; J, Aviation Fuels; K, Cutting Fluids; L, Tractor Fuels. Under each technical committee are various sections. For example, Com-



"Photograph courtesy Standard Oil Co. Ohio"

The end point of a new petroleum plant, such as is partly illustrated, is improved petroleum products, many of the properties of which are evaluated by A.S.T.M. methods developed by Committee D-2. This committee has had an extremely active year.

mittee E has sections on Reference Fuels, Burner Tests, Fuel Oil Specifications, and Illuminating Oils. Then there is a group of Research Divisions concerned with Combustion Characteristics, Sampling, Elemental Analysis, etc. These in turn will have various sections, so that the work is concentrated in smaller groups. This reorganization has resulted in intensive work, and is a real accomplishment for 1949.

Technical Symposiums and Sessions:

Committee D-2 would have had a notable year if the only thing credited to it were the several symposiums it sponsored at the Pacific Area National Meeting in October in San Francisco. The two formal symposiums on High Additive Content Oils and Turbine Oils evoked much interest and will be published during 1950. Two other symposiums of a more informal nature, but still very significant, with numerous papers, covered the Effect of Fuel upon Diesel Engine Deposits, and the Modern Chemical and Instrumental Methods for the Determination of Metals in Petroleum Products.

Another pertinent symposium developed by Technical Committee C, Turbine Oils, was the Symposium on Lubrication of High-Speed Gears, held in February; the four papers were published in the year.

Paints and Related Materials:

An outstanding contribution from Committee D-1 on Paint, Varnish, Lacquer and Related Materials, was the session covering new methods for testing paints and paint materials at the Pacific Area Meeting. Ten of the papers were sponsored by Committee D-1. There were three technical papers presented at this time dealing with aircraft varnishes. This was an all-day meeting running morning and afternoon.

Several new tentative specifications and tests were developed, and many of the well over 100 standards for which the committee is responsible were revised and brought up to date.

Tests for Gaseous Fuels:

Since its organization in 1935, Committee D-3 on Gaseous Fuels has carried out extensive research work involving specific gravity of gaseous fuels. Much of this work has been done at the National Bureau of Standards; many members of the committee have cooperated in round-robin tests. All of this work has been preliminary to the development of standard tests and it is certainly a major accomplishment for the committee in that the new tentative tests for specific gravity (D 1070) and the methods for the measuring of gaseous fuel samples have just been approved. Together with the test for calorific value (D 900), these methods are being issued in a special compilation of standards shortly to be available.

Wood and Wood Poles:

In the standardization activities of Committee D-7 on Wood, two important items should be noted, first the establishment of the Tentative Static Tests of Wood Poles (D 1036) and second, the extensive revisions of the Recommended Practices for Establishing Structural Grades of Lumber (D 245). The committee's work in correlating methods for chemical analysis of various types of preservatives such as zinc chloride, tanalith, etc., should be noted, as well as the approval of specifications for preservatives not previously covered.

The work on testing of wood poles merits some further reference. There is definite need for specific information and data on the strength of wood poles, and Committee D-7 has considered various methods of testing in agreeing on the new Tentative method D 1036. At the 1949 Annual Meeting there was a round-table discussion on this subject, and in the September BULLETIN there was published a detailed discussion of a program for testing wood poles to determine allowable fiber stresses, this article being prepared by Col. L. G. Smith, Chairman of the Committee D-7 Task Group. Further announcements will be made as the program gets under way. This subject is one of outstanding importance.

Rubber Electric Protective Equipment:

During the war, under the auspices of American Standards Association, there was developed a group of specifications for rubber safety equipment which were adopted as war standards. In order that the great amount of experience and information in this standard would be continued on a peace-time basis, A.S.T.M. Committee D-11, Subcommittee IV, which is set up as Section Committee J-6 under the American Standards Association procedure, has completely

rewritten the specifications and they have been issued as A.S.T.M. tentatives. They cover the following:

Tentative specifications for:
Rubber Blankets—D 1048
Rubber Hoods—D 1049
Rubber Line Hose—D 1050
Rubber Sleeves—D 1051

Aging of Rubbers:

Latest information on many questions and problems that arise in evaluating the aging effects of various elements and environment on different types of rubbers was covered in a six-paper symposium featured at the separate meeting sponsored by Committee D-11. These papers were by leading authors who discussed effects of air, sunlight, heat, ozone, and other related materials. This symposium appeared in June, 1949.

Standards for Latex:

The importance of standard specifications for latex was emphasized in the 1948 report of Committee D-11. The use of these materials and rubber-dipped and coated products, together with the necessity of having standards of quality because of the impact of foreign trade, led Committee D-11 to develop specifications that were published first as information and then just recently approved as A.S.T.M. tentatives.

The designations of the new tentatives covering various types of rubber latex are D 1055, D 1056, and D 1076.

Crude Rubber:

It is very significant that Committee D-11 has decided to establish a new committee on crude natural rubber. The importance of this material, and the necessity of standards will focus much attention on this work.

Soils for Engineering Purposes:

While the publication of the greatly expanded compilation of standards and proposed methods for evaluating various properties of soils of all kinds is still forthcoming (about March, 1950), the year 1949 should be assigned as the one in which this extensive work virtually came to fruition. Committe D-18 on Soils for Engineering purposes has been hard at work for many months collecting various methods that are used for testing soils in addition to the large number of standard methods which it has completed and which have been issued by A.S.T.M. Following the receipt of the various methods, the major task of detailed studying and editing was taken in hand the latter part of 1949. This editing and the subsequent study by committee members was very time consuming, but will result soon in a publication of great value and interest to all those concerned with soils, and this includes a host of technical men in highway departments, airfield work, building foundations, and the like. Not only is it amazing to learn of the large number of people interested, but also the number of industrial fields where studies of soils are important.

Core Sampling of Wool:

It is difficult to single out from the large number of active projects in the textile committee any which might be high-lighted. However, of a distinctive interest to the wool group was the new Method of Core Sampling of Wool (D 1060). These methods can be used to obtain a sample of material in bails or bags. Of directly related interest was a paper at the Annual Meeting dealing with Sampling of Bulk Materials by Messrs. Tanner and Demming. The latter is being published in the 1949 *Proceedings*.

Stretch of Hosiery:

Reference might be made to the new Method of Test for Stretch of Hosiery (D 1058). The test applies to this material (which comes directly under the category of ultimate consumer goods) regardless of the methods of manufacture, materials, or construction used for the hosiery.

Water-Borne Industrial Wastes:

Notable progress was made during the year in organizing the work on water-borne industrial wastes. This is concentrated in the Subcommittee of Committee D-19 on Industrial Water. The importance of the work and the interest in it is indicated by the large number of men serving on the subcommittee. Four sections have been established covering Critical Constituents; Methods of Analysis; Methods of Sampling, Gaging and Preservation; and Reporting Results of Analysis. The committee sponsored a round-table discussion at the 1949 Annual Meeting in Atlantic City on the need for standards for the examination of water-borne industrial wastes as published in the December ASTM BULLETIN. All of those concerned with this work will find this material of particular interest. Among other things it gives a clear picture of some of the objectives of the committee's work. Concisely stated, this is to provide authoritative material on the measurement, sampling and analysis, and characterization of water-borne industrial wastes, particularly the wastes within the confines of a plant, and not in the stream below a plant.

Plastic Film and Sheeting:

A significant development in the work of Committee D-20 on Plastics, was the new Test for Tear Resistance of Plastic Film and Sheeting (D 1004). Established jointly with the Society of Plastics Industry, this procedure will take care of an urgent need. At the same time, the committee completed extensive revisions of the test for Tensile Properties of Thin Plastic Sheets and Films (D 882), also prepared jointly with the S.P.I.

Plasticizers:

Another notable development in the field of plastics was the new method of sampling and testing plasticizers. The first standard of this kind issued and developed by Committee D-20 (designated D 1045) covers sampling, acidity, ester content, specific gravity and color.

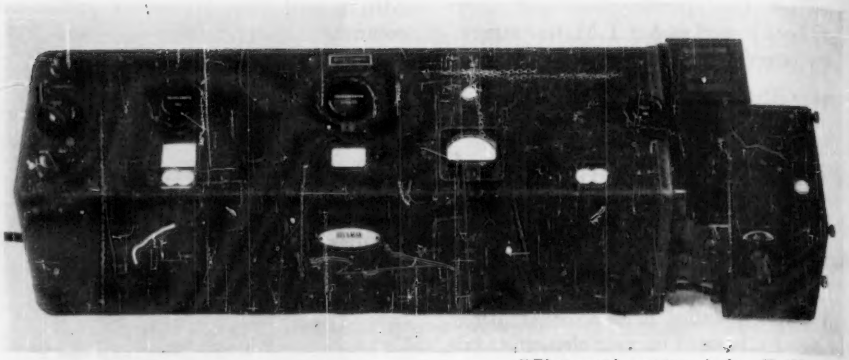
Miscellaneous Testing Problems:

Committee E-1 on Methods of Testing covers a wide range of problems and during the past year set up task groups to study and to make recommendations on various tests which would be of interest to different A.S.T.M. technical committees. For example, the task group on Distillation Tests will review the possibility of further simplification and standardization of the several distillation methods now covered in different standards. The group on Water Vapor Permeability likewise will consider simplification of tests used to evaluate permeability and transmission characteristics of materials. Another subject being studied by a task group recently appointed involves low-temperature testing of elastomeric and plastic materials.

Absorption Spectroscopy:

During the year on the recommendation of Committee E-2, its title and scope was limited to the field of Emission Spectroscopy. The Board of Directors, in concurring with Committee E-2 that the important field of absorption spectroscopic techniques should not be included in the same committee with emission spectroscopy but in a separate group, authorized the organization of a separate technical committee. There has been considerable preliminary work carried out and it is expected

that within the next few weeks an organization meeting will be held. Meanwhile, it can be announced that W. R. Brode, Assistant Director, National Bureau of Standards, has accepted the temporary chairmanship of the new group. Since he is an outstanding authority in this field who has helped to prepare several reports for A.S.T.M., it can be expected that Dr. Brode and those who will be associated with him will soon have an active program of work under way.



"Photograph courtesy Arthur H. Thomas"

This is an example of one of the instruments used in analysis by absorption spectrography. Work in this field is being clarified by the appointment of a new technical committee to concentrate on emmission spectrography. A later Bulletin will give details of the 1950 Edgar Marburg Lecture which will cover this field of spectrographic analysis.

Many New and Revised Standards on Steel, Nickel Alloys, Non-Ferrous Metals, Cast Iron, Rubber Products and Test Methods

Standards Committee Accepted Many Recommendations in December

LARGELY through numerous recommendations on standards coming from Committee A-1 on Steel and Committee B-2 on Non-Ferrous Metals and Alloys, but also actions from other technical groups, the Society, through its Administrative Committee on Standards, approved many new and revised tentatives during December. The accompanying table lists all of the actions together with the latest designations.

In the interval between annual meetings the Administrative Committee on Standards can review recommendations affecting specifications and tests which have been approved in the technical committees. This committee may act at meetings or by letter ballot. Essentially the Standards Committee decides whether a substantial consensus has been reached in the technical group and whether all of the regulations in connection with standards have been met. The personnel of the Standards Committee includes leading authorities who have a wide range of interest and activity, and who have been active in the Society for many years. Appointment to the committee is by action of the Board of Directors.

All of the specifications and tests noted in the accompanying table will appear in the respective Parts of the 1949 Book of Standards; some will be included in special compilations, and all of the items will be available relatively soon in separate pamphlet form.

Steel and Steel Products:

Steel Forgings.—The numerous recommendations listed in the table covering steel and steel products cover, it will be noted, quite a variety of products, but one major group of specifications should especially be noted—those covering steel forgings. Subcommittee VI, which is responsible for these specifications, has had studies under way for the past year or two. Each specification has been reviewed in detail and it is believed the latest drafts bring the requirements in line with current industrial practice. Those who have gone through the experience of bringing a relatively large group of specifications up to date and making them consistent one with the other will realize the tremendous amount of time and energy involved.

One group of the forging specifications, namely those covering materials for turbines and generators, were developed first as emergency specifications during the war and aided in expediting production of these important products. Subsequently they became A.S.T.M. tentatives, and most of them were last revised in 1947.

In the 1930's when Subcommittee VI made a complete study of its specifications four basic standards resulted carrying the designations A 235 through A 238, inclusive. These covered carbon- and alloy-steel forgings for general industrial use and for railroad use. Subsequently other products were covered such as ring and disk forgings, steel drums, and others.

In the latest revisions the chemical composition for each of the carbon and alloy grades has been reviewed; an attempt has been made to set the physical requirements consistent with manufacturing practice; and the testing procedures have been carefully scrutinized. It should be noted that all of the forging specifications are now in the tentative status since several standards have been reverted to tentative as revised.

Plates for Pressure Vessels, Bolting Material, Bars, Castings, etc.—A miscellaneous group of steel specifications in which revisions have been approved cover various types of plates for pressure vessels, commercial bar steels, steel bolting, concrete reinforcement bars, castings for high-temperature service etc. One completely new tentative covers quenched-and-tempered steel bolts and studs (A 325). There is considerable usage of this particular material in the electrical, automotive, and farm equipment industries. Essentially the material is to be used where higher strength is required and covers diameters up to $1\frac{1}{2}$ in. The minimum tensile strength of $1\frac{1}{2}$-in. material is 105,000 psi. with a yield strength of 74,000 psi. For smaller sizes the tensile strength minimum is 125,000 psi.

(continued on p. 16)

Actions of A.S.T.M. Administrative Committee on Standards, December, 1949

New Tentatives

Specifications for:

Alloy Steel Castings for Pressure Containing Parts Suitable for High Temperature Service (A 217 – 49 T) (Consolidation of A 217 and A 157).

Quenched and Tempered Steel Bolts and Studs with Suitable Nuts and Plain Washers (A 325 – 49 T).

Standard Weight Zinc-Coated (Galvanized) Steel Core Wire for Aluminum Conductors, Steel Reinforced (ACSR) (B 245 – 49 T).

Specifications and Methods of Test for:

Concentrated, Ammonia Preserved, Creamed and Centrifuged Natural Rubber Latex (D 1076 – 49 T).

Methods of Test for:

Determining the Curing Characteristics of Vulcanizable Mixtures During Heating by Means of Shearing Disk Viscometer (D 1077 – 49 T).

Evaluating Pressure Sealing Properties of Rubber and Rubber-Like Materials (D 1081 – 49 T).

Method for:

Estimating the Average Grain Size of Wrought Copper and Copper-Base Alloys (E 79 – 49 T).

Preparing Quantitative Pole Figures of Metals (E 81 – 49 T).

Determining the Orientation of a Metal Crystal (E 82 – 49 T).

Recommended Practice for:

Dilatometric Analysis of Metallic Materials (E 80 – 49 T).

Tentative Revisions of Standards

Specifications for:

Billet-Steel Bars for Concrete Reinforcement (A 15 – 39).

Rail-Steel Bars for Concrete Reinforcement (A 16 – 35).

Heat-Treated Steel Elliptical Springs (A 147).

Axle-Steel Bars for Concrete Reinforcement (A 160 – 39).

Factory-Made Wrought Carbon-Steel and Carbon-Molybdenum-Steel Welding Fittings (A 234 – 44).

Methods of:

Testing Compressed Asbestos Sheet Packing (D 733 – 49).

Revision of Standard and Reversion to Tentative

Specifications for:

Carbon-Steel Forgings for General Industrial Use (A 235 – 46).

Carbon-Steel Forgings for Locomotives and Cars (A 236 – 46).

Alloy-Steel Forgings for General Industrial Use (A 237 – 46).

Alloy-Steel Forgings for Locomotives and Cars (A 238 – 46).

Carbon-Steel and Alloy-Steel Ring and Disk Forgings (A 243 – 46).

Carbon-Steel Seamless Drum Forgings (A 266 – 47).

Revision of Tentatives

Ferrous

Specifications for:

Boiler and Firebox Steel for Locomotives (A 30 – 49 T).

Foundry Pig Iron (A 43 – 45 T).

Hot-Rolled Carbon-Steel Bars (A 107 – 49 T).

Cold-Finished Carbon-Steel Bars and Shafting (A 108 – 49 T).

Seamless Alloy-Steel Pipe for High-Temperature Service (A 158 – 48 T).

Alloy-Steel Bolting Materials for High-Temperature Service (A 193 – 48 T).

Carbon-Silicon Steel Plates of Intermediate Tensile Ranges for Fusion-Welded Boilers and Other Pressure Vessels (A 201 – 49 T).

Nickel-Steel Plates for Boilers and Other Pressure Vessels (A 203 – 49 T).

Molybdenum-Steel Plates for Boilers and Other Pressure Vessels (A 204 – 49 T).

High Tensile Strength Carbon-Silicon Steel Plates for Boilers and Other Pressure Vessels (Plates 6 in. and Under in Thickness) (A 212 – 49 T).

Manganese-Vanadium Steel Plates for Boilers and Other Pressure Vessels (A 225 – 49 T).

Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650 F. (A 278 – 44 T).

Low and Intermediate Tensile Strength Carbon-Steel Plates of Flange and Firebox Qualities (Plates 2 in. and Under in Thickness) (A 285 – 49 T).

Carbon-Steel and Alloy-Steel Forgings for Magnetic Retaining Rings for Turbine Generators (A 288 – 47 T).

Alloy-Steel Forgings for Nonmagnetic Coil Retaining Rings for Turbine Generators (A 289 – 47 T).

Carbon-Steel Forgings for Rings for Main Reduction Gears (A 290 – 46 T).

Carbon-Steel and Alloy-Steel Forgings for Pinions for Main Reduction Gears (A 291 – 47 T).

Carbon-Steel and Alloy-Steel Forgingings for Turbine Generator Rotors and Shafts (A 292 – 47 T).

Carbon-Steel and Alloy-Steel Forgings for Turbine Rotors and Shafts (A 293 – 47 T).

Carbon-Steel and Alloy-Steel Forgings for Turbine Bucket Wheels (A 294 – 47 T).

Corrosion-Resistant Iron-Chromium and Iron-Chromium Nickel Alloy Castings for General Application (A 296 – 49 T).

Heat-Resistant Iron-Chromium and Iron-Chromium-Nickel Alloy Castings for General Application (A 297 – 49 T).

High Tensile Strength Carbon-Manganese-Silicon Steel Plates for Boilers and Other Pressure Vessels (A 299 – 47 T).

Chromium-Molybdenum Steel Plates for Boilers and Other Pressure Vessels (A 301 – 49 T).

Manganese-Molybdenum Steel Plates for Boilers and Other Pressure Vessels (A 302 – 49 T).

Steel Machine Bolts and Nuts and Tap Bolts (A 307 – 49 T).

Alloy-Steel Bolting Materials for Low-Temperature Service (A 320 – 48 T).

Non-Ferrous

Magnesium-Base Alloy Sheet (B 90 – 49 T).

Magnesium-Base Alloys in Ingot Form for Sand Castings, Die Castings and Permanent Mold Castings (B 93 – 49 T).

Magnesium-Base Alloy Die Castings (B 94 – 48 T).

Magnesium-Base Alloy Bars, Rods, and Shapes (B 107 – 49 T).

Nickel-Copper Alloy Plate, Sheet, and Strip (B 127 – 41 T).

Nickel Rods and Bars (B 160 – 41 T).

Nickel Cold-Drawn Pipe and Tubing (B 161 – 41 T).

Nickel Plate, Sheet, and Strip (B 162 – 41 T).

Nickel, Nickel-Copper Alloy, and Nickel-Chromium-Iron Alloy Seamless Condenser Tubes and Ferrule Stock (B 163 – 41 T).

Nickel-Copper Alloy Rods and Bars (B 164 – 41 T).

Nickel-Copper Alloy Cold-Drawn Pipe and Tubing (B 165 – 41 T).

Nickel-Chromium-Iron Alloy Rods and Bars (B 166 – 41 T).

Nickel-Chromium-Iron Alloy Cold-Drawn Pipe and Tubing (B 167 – 41 T).

Nickel-Chromium-Iron Alloy Plate, Sheet, and Strip (B 168 – 41 T).

Magnesium-Base Alloy Permanent Mold Castings (B 199 – 47 T).

Magnesium-Base Alloy Extruded Round Tubing (B 217 – 48 T).

Specifications and Methods of Test for:

Latex Foam Rubbers (D 1055 – 49 T).

Sponge and Expanded Cellular Rubber Products (D 1056 – 49 T).

Methods of:

Test for Compression Set of Vulcanized Rubber (D 395 – 47 T).

Test for Changes in Properties of Rubber and Rubber-Like Materials in Liquids (D 471 – 46 T).

Testing Asphalt Composition Battery Containers (D 639 – 46 T).

Test for Indentation of Rubber by Means of a Durometer (D 676 – 47 T).

Test for Viscosity of Rubber and Rubber-Like Materials by the Shearing Disk Viscometer (D 927 – 47 T).

Recommended Practice for:

Identification of Crystalline Materials by the Hanawalt X-ray Diffraction Method (E 43 – 46T)

Withdrawal of Standard

Specifications for:

Steel Helical Springs (A 61 – 39).

Steel Elliptical Springs (A 62-39).

ASTM Bulletin Covers Standards Actions

ONE of the most important, and in the opinion of many *the* most important function of A.S.T.M. is its promulgation of adequate and authoritative standard specifications and tests. No matter how initiated or what technical committee is responsible, all new tentatives and revised tentatives and full standards must receive Society approval. This may be at an annual meeting and by letter ballot or in certain cases through action by the Administrative Committee on Standards. The point is that there is a continuing output of new and revised standards throughout the year. These will continue to be publicized in the ASTM BULLETIN in so far as possible, and while we cannot adequately give a full background of whys and wherefores we will continue the attempt to give in the BULLETIN complete listing of the items and in many cases some comments. Members and others who wish to keep in touch with standards activities should note each issue of the BULLETIN.

One other tentative which is really a consolidation of two existing specifications, covers alloy steel castings for high-temperature service. This is a consolidation of A 217 and A 157. It covers nine grades of ferritic steel, such as carbon-molybdenum, chromium-molybdenum, and other alloys with the tensile strength ranging from 65,000 to 95,000 minimum psi., and elongations from 15 to 24 per cent in 2 in.

Concerning the plate specifications, Tentatives A 201, A 212, and A 299 have modified heat treatment sections. Other specifications with modified heat-treatment requirements include A 203, A 204, A 225, A 301, and A 302.

The widely used Tentatives A 30 and A 285 incorporate a note with respect to determination of carbon content and certification in flange quality steel where the required mechanical properties and current mill practice normally result in a carbon content of 0.35 per cent or less.

Of the several specifications for bolting materials and commercial bars, A 320, a significant specification covering materials for low-temperature service, has a minor change in the carbon content of grade L7, which will now read 0.38 to 0.48 per cent. This is A.I.S.I. grade 4145. In Specifications A 193, which is bolting material applicable for high-temperature service, there is a provision concerning the stabilization of austenitic steel and several of the grades have modified chemical requirements with check analysis variations.

In the requirements for steel machine bolts and nuts (A 307) a second grade of bolt with a minimum tensile strength of 55,000 psi. (same as the present grade) but with a maximum of 90,000 psi. added. This latter grade has considerable application in the valve and fitting industry.

In the commercial bar fields, Specifications A 108 was rather extensively modified. Among other changes, a section on supplementary requirements covering special processing and treatment has been added. Change in Specifications A 107 was very minor, reducing the top carbon in grade 1095 to 1.03 per cent.

Concerning welding fittings, in Specifications A 234, a grade of chromium-molybdenum was added as a tentative revision.

In the reinforcing bar specifications (A 15, A 16, A 160) modifications are set up tentatively, subject to later inclusion in the standard, involving elongation requirements and the bend test.

Tentative revisions have been approved in the Standard Specifications for Heat-Treated Steel Elliptical Springs A 147, which brings them into line with the latest commercial practice. At the same time, two other standards, A 61 and A 62, were discontinued.

Intensive studies by a special subgroup of Subcommittee IV of Committee A-1, which group was interested in hot-formed springs, resulted in proposed changes in A 125, but certain objections to some of the proposals arose and they are to receive further consideration.

Stainless Steel Castings:

For about two years, Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys has been working with the Alloy Casting Institute to reconcile the chemical compositions of several grades of steel covered in both Specifications A 296 and A 297, and the revisions in these two tentatives have resulted from this work. In both specifications the A.C.I. designations are being adopted, as well as modified chemical requirements.

Nickel-Alloy Specifications:

Committee B-2 on Non-Ferrous Metals and Alloys has done intensive work during 1949 on ten of the nickel-alloy specifications for which it is responsible, covering plate, sheet and strip, bars, pipe and tubing, and related materials. The committee has recommended a number of significant changes, all intended to bring the tentatives in line with commercial practice. The specifications were last revised in 1941, and it is expected, that as modernized and amplified, they will come into still wider use. Because of the many specifications involved, it is not possible to detail the various changes. It is suggested the complete specifications as they appear in Part 2 of the 1949 Book of Standards be consulted.

Magnesium-Base Die Castings:

The change in the Magnesium-Base Die Castings Specification B 94 provides for a new Alloy AZ91B, and a redesignation of the present Alloy AZ91 as AZ91A. This has more restricted chemical requirements than the new alloy. In connection with the new composition there is a supplementary note reading as follows: "The corrosion resistance of Alloy AZ91B is impaired by the higher copper content, and castings made from this alloy should be used under a known range of atmospheric conditions for which their life can be considered satisfactory."

A companion change in the Ingot Specification B 93 will provide basic material for the new die-casting Alloy AZ91B.

Magnesium-Base Alloy Products:

In the Magnesium-Base Sheet Specification B 90, and the Bar and Shape Tentative B 107 a retest section is being added. The Permanent Mold Casting Tentative B 199 will have the minimum tensile strength of two alloys, A10 and AZ92, increased from 32- to 34,000 psi. Also in B 107 certain modified physical properties are being incorporated.

Foundry Pig Iron, and Gray Iron Castings for Elevated Temperature Service:

The Specifications for Foundry Pig Iron A 43 include many grades of commercial materials available. The designations of these are all being modified to incorporate A.I.S.I. designations. At the same time the silvery grades of pig iron were not complete and the requirements did not represent current commercial practice, so appropriate changes have been made.

The changes in the requirements for gray iron castings for temperatures up to 650 F. bring them in line with certain of the requirements of the A.S.M.E. Pressure Vessel Code.

Aluminum Conductors:

In order that the steel reinforcing wires referred to in the Concentric-

Lay Stranded Aluminum Conductors, Steel-Reinforced, Specifications B 232, could be adequately covered, it was necessary to issue the new Tentative B 245 which covers the zinc-coated steel core wire. Two types are provided, one applicable for single or multiple wire cores, the other only for multiple wire cores.

Grain Size of Copper Alloys:

The new method for estimating the grain size of copper alloys will replace the requirements formerly included in E-2 which was a blanket standard relating to various metals and alloys in addition to copper. The new chart that is included in E 79 will provide a useful comparison chart and establishes a logical system of grain size determinations.

Dilatrometric Analysis and Metal Crystals:

The need of a standard practice to measure thermal expansion and contraction has been recognized for a number of years, and the new Method for Dilatrometric Analysis (E 80) will therefore be of considerable service. Started before the war, with work pretty much at a standstill for several years, the studies were intensified during 1949 and finally concluded. Measurements of length and temperature and other thermal properties are usually made for one of several purposes such as finding the critical temperatures (phase changes), establishing the coefficient of thermal expansion, or for simulated service tests.

Frequently data on the orientation of metal crystals are desired and sometimes are necessary in metallurgical investigations. The new A.S.T.M. Tentative E 82 will provide standardized procedures. It relates largely to the use of X-ray diffraction, specifically the Laué method. A bibliography is included with the procedures and considerable tabular material is a part of the standard.

Metallurgical investigations of cold-worked metals and of recrystallized metals having a very fine grain size have revealed the need of a *quantitative* method of preparing pole figures of metals. The new Tentative E 81 describes the Geiger counter spectrometer method for fulfilling this need.

X-ray Diffraction:

The growing use of the Hanawalt method of X-ray diffraction identifications of crystal materials has stimulated much interest in the A.S.T.M. Tentative E 43. The current changes being recommended have resulted from comments by users of the methods. Certain corrections also have been made.

Rubber and Rubber-Like Materials:

Of the numerous actions on standards recommended by Committee D-11 three are new tentatives issued for the first time. The new specifications for rubber latex—D 1076—will meet a frequently expressed need for quality requirements in test methods. They were published in the 1949 preprinted report of Committee D-11. Two types are covered: Type I.—Centrifuged natural latex preserved only or by formaldehyde followed by ammonia and Type II.—Creamed natural latex preserved with ammonia only or by formaldehyde followed by ammonia.

The test for sealing properties of rubber-like materials—D 1081—is particularly of value in connection with gasketing materials. Originally developed by the Bureau of Ships it is now required in certain Navy standards.

The new methods D 1077 for determining curing characteristics during heating essentially evaluates the scorched properties of rubber compounds. A shearing disk viscometer is the principal instrument described.

Concerning the revisions in various methods for which Committee D-11 is responsible, those in the test for compression set D 395 add a new heating period which has come into wide use. There are now two periods covered—22 hr. at 70 C. and 70 hr. at 100 C.

Modifications in the test of rubber in liquids—D 471—specify the use of acetone instead of alcohol, and in the test for Battery Condensers D 639 a slight change in procedure will improve the reproducibility of the acid absorption test.

The Durometer Hardness Test D 676 will have its scope broadened, the indentor tolerances changed, and the calibration clarified.

Revisions in the viscosity test D 927 include editorial changes, the definition of the test temperature, and other improvements.

Numerous changes in the tentatives, D 1056 for sponge rubbers and D 1055 for latex foam rubber, were proposed by the technical committee on automotive rubber.

1950 Annual Meeting in Atlantic City

THE Administrative Committee on Papers and Publications will be meeting shortly to develop the program for the annual meeting of the Society to be held at the Chalfonte-Haddon Hall in Atlantic City in June. A number of offers of papers are now being received and the committee has before it the proposals to arrange for Symposia on Testing Soils Under Triaxial Loading, Effect of Sigma Phase on the Properties of Metals at Elevated Temperatures, Corrosion and Erosion of Gas Turbine Materials, and Sampling of Bulk Materials. Prospective authors should request blanks for offers as soon as possible. These, completed, should be sent to the Papers Committee at Headquarters by January 30 so they can be considered for the Annual Meeting.

(See article on Preparation of Papers p. 38, this BULLETIN.

Photographic Exhibit.—Members should keep in mind the Seventh Photographic Exhibit that is being sponsored by the Philadelphia District. An entry blank will go forward to all members in the very near future, but in the meantime members may wish to reserve any prints which would be appropriate or display.

Exhibit of Testing Apparatus.—The exhibit of testing apparatus is always an interesting one, and this year promises to compare favorably with those that have been held in the past. A number of applications for space have already been received.

Entries for 1950 Photographic Exhibit and Competition

THE Seventh Photographic Exhibit and Competition will be held during the 1950 Annual Meeting in Atlantic City during the week of June 26. While the exact theme has not been established by the committee in charge, it will undoubtedly be on the general subject "Materials, Testing and Research." Members and committee members will receive an entry blank describing the exhibit. Meanwhile, those interested are urged to keep the exhibit in mind and earmark any prints which they might like to enter.

ASTM Bulletin

JANUARY 1950

NO. 163

NINETEEN-SIXTEEN
RACE STREET
PHILADELPHIA 3, PENNA.

Symposiums on Insulating Oil

PRODUCERS and consumers of electrical insulating oil are vitally interested in any means of improving oil life in apparatus and with the development of tests which insure accurate appraisal of the serviceability of new or in-service oils. Because of this interest, a reprint (ASTM BULLETIN—May and December, 1947) has just been published which includes the first two of three series of papers on insulating oil serviceability which were presented originally at the Society's 1946 and 1947 Annual Meetings.

The third series, also just off the press as a pamphlet, contains papers presented at D-9's Washington Meeting on March 23, 1949. These papers discuss askarels from the standpoints of identification, quality control, and performance; oil quality maintenance by the utilities; and the merits of inhibited transformer oils.

The symposia were developed by D-9's subcommittee on liquid insulation.

The reprint contains the following papers and discussions:

First Series
- Steam-Emulsion Number as an Index of Transformer Oil Serviceability—M. D. Baker
- The Interfacial Tension Test and Its Significance in Appraising Performance of an Insulating Oil—G. W. Gerell
- Application of the Interfacial Tension Test in Grading Oil in Transformers Relative to Serviceability—E. F. Walsh
- Joint Discussion
- Refresher on Statistical Analysis Applied to Two A.S.T.M. Oil Dielectric Strength Test Procedures—E. W. Greenfield

Second Series
- Advantages of an Inhibited Transformer Oil—T. E. Reamer and R. G. Larsen. Discussion
- Oxidation Inhibitors in Electrical Insulating Oils—Leo J. Berberich. Discussion
- Power Factor of Insulating Oils, Its Significance and Methods of Testing. Stability—J. C. Balsbaugh. Discussion
- Serviceability Tests on Transformer Oil from the Viewpoint of the Maintenance Engineer—Frank J. Pobnan. Discussion

The new pamphlet contains the following additional papers and discussions:

Third Series
- Introduction—E. A. Snyder and L. B. Schofield
- Performance Characteristics of the Askarels—F. M. Clark. Discussion
- One System of Laboratory Testing to Appraise Serviceability of Oils in Transformers—R. G. Call. Discussion
- Performance of Inhibited Transformer Oils—G. H. von Fuchs. Discussion

Copies of the 48-page symposium reprint on Insulating Oil can be obtained for 75 cents and by A.S.T.M. members for 60 cents. The 53-page pamphlet is $1; 75 cents to members. All three symposia are $1.35; to A.S.T.M. members $1.

Schedule of, A.S.T.M. Meetings

DATE	GROUP	PLACE
January 16–17	Board of Directors	(A.S.T.M. Headquarters)
January 19–20	Committee B-1 on Wires for Electrical Conductors	(A.S.T.M. Headquarters)
January 24–26 (Tentative)	Committee B-5 on Copper and Copper Alloys, Cast and Wrought	(A.S.T.M. Headquarters)
January 30–February 1	Committee A-1 on Steel	Philadelphia, Pa.
January 31	Philadelphia District	Philadelphia, Pa.
February 15	Committee B-9 on Metal Powders and Metal Powder Products	New York, N. Y.
February 16–17	Committee D-15 on Engine Anti-Freezes	Washington, D. C.
February 20–24	Committee D-2 on Petroleum Products and Lubricants	Washington, D. C.
February 24	Committee D-6 on Paper and Paper Products	New York, N. Y.
February 27–March 3	Committee Week	Pittsburgh, Pa.
March 8	Philadelphia District	Philadelphia, Pa.
March 8	Joint S.A.E.-A.S.T.M. Technical Committee on Automotive Rubber	Detroit, Mich.
March 15–17	Committee D-13 on Textile Materials	New York, N. Y.
Wk. March 20 (Tentative)	Committee D-9 on Electrical Insulating Materials	Old Point Comfort, Va.
Wk. March 20	Committee D-20 on Plastics	Old Point Comfort, Va.
April 27–28	Committee D-10 on Shipping Containers	Madison, Wis.
June 26–30	53rd Annual Meeting and 9th Exhibit of Testing Apparatus and Equipment	Atlantic City, N. J.

Standards Important in Research on Gaseous Fuels

Case Histories Show Significance of Standard Test Methods in Research on Problems in Gas Industry

CONTINUING the series of articles in the September, October, and December, 1949, BULLETINS on the significance of standards, specifically standard test methods, in spearheading research and aiding in the development of improved or new products, there are presented below some interesting examples of the application of A.S.T.M. standards in important research work carried out by the American Gas Association Laboratories. This information is based on a letter addressed to the A.S.T.M. Committee on Developmental Activities by K. R. Knapp, Assistant Director of the A.G.A. Laboratories and Secretary of Committee D-3 on Gaseous Fuels.

The information is interesting and significant not only because it presents some excellent examples of the general subject being covered in the BULLETIN series, but it also focuses attention on the variety of problems and materials which may be involved in one general field such as gaseous fuels. One might not expect that hardness conversion tables or methods of preparing metallographic specimens would be among tests used. The fact is that a great many of the A.S.T.M. testing procedures and recommended practices find important usages beyond the actual scope for which they were originally intended.

However, the aim of the Developmental Committee in presenting this series is to present to our members (and through them acquaint management with) the significance of standard specifications and tests.

Mr. Knapp has been secretary of Committee D-3 on Gaseous Fuels since 1947 and prior to that time was active in the work through his association with Mr. R. M. Conner, who was the Secretary of the committee serving from its organization in 1935 through 1947.

Standards and Research

By K. R. Knapp

The principal use made by our Laboratories of various A.S.T.M. test methods has been in the conduct of different phases of research in gas utilization as well as in investigational studies necessary in the preparation and extension of National Safety Standards covering gas-burning equipment. In the research field we have for a number of years been conducting a very extensive program of Domestic Gas Research. This has as its objective the securing of fundamental information leading to the further improvement of domestic gas-consuming equipment. This entire study is divided into several parts, each dealing with a distinct phase. Various research bulletins have been published, each devoted to a specific project. For the purpose of presenting the information you desire, I believe the best way is to give the title of the particular bulletin in question and show opposite it the A.T.S.M. test methods which were employed in the conduct of the research it represents.

In our studies for preparation and extension of National Safety Standards which we usually designate by the term "Requirements Investigations," we have utilized existing test methods extensively. This has been particularly true in studies recently conducted on semirigid tubing of the type commonly employed on gas appliances. Another investigation recently initiated and which will necessitate extensive use of test methods is a study of properties of ceramic materials employed in gas-fired conversion burners. I am giving below the test methods employed in connection with each activity, as well as one used in the case of a third investigation which it seems desirable to include.

A.G.A. Laboratories Research Bulletin		*A.S.T.M. Test Method Employed*	
No. 40	A Study of Various Methods of Kitchen Ventilation	D 337	Method of Determining Relative Humidity
No. 49	Study of Accumulation of Combustible Deposits in Kitchen Ventilating Systems	D 337	Method of Determining Relative Humidity
No. 42	A Study of Bimetallic Thermal Elements	A 224	Recommended Practice for Conducting Plant Corrosion Tests
No. 54	Investigation of Causes and Prevention of Closure of Oven Burner Ports	E 10	Methods of Test for Brinell Hardness of Metallic Materials
		E 18	Methods of Test for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
		E 3	Methods of Preparation of Metallographic Specimens
		E 2	Methods of Preparation of Micrographs of Metals and Alloys
		E 48	Hardness Conversion Tables for Steel

A.G.A. Laboratories Requirements Investigations	*A.S.T.M. Test Method Employed*	
Requirements Investigations of Semirigid Tubing	B 210	Specifications for Aluminum Alloy Drawn Seamless Tubing
	B 88	Specifications for Copper Water Tube
	B 75	Specifications for Seamless Copper Tubes
Requirements Investigations of Semirigid Tubing (Contd.)	A 254	Specifications for Copper Brazed Steel Tubing
	E 8	Methods of Tension Testing of Metallic Materials
	E 18	Methods of Test for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
Properties of Ceramic Materials Used in Gas Conversion Burners	C 38	Methods for Basic Procedure in Panel Spalling Test for Refractory Brick
	C 24	Method of Test for Pyrometric Cone Equivalent (P.C.E.) of Refractory Materials
Studies of Gas Cock Lubricants	D 217	Method of Test for Cone Penetration of Lubricating Grease

The relationship between test method development and its later use in research represents a subject which is more difficult to provide a specific answer for in our case. As the outstanding example, however, I would like to make mention of a test method prepared by Committee D-3 on Gaseous Fuels. This is A.S.T.M. Method D 900, Standard Method of Test for Calorific Value of Gaseous Fuels by the Water Flow Calorimeter. This particular method has only recently become available. It has, however, been of great value to us, not only in the conduct of our research investigations, but in other activities. It is expected that more and more use will be made of this method in the future as the need arises. Incidentally, this method is the first developed by Committee D-3 on Gaseous Fuels. A number of others dealing with methods for specific gravity determination, chemical analysis, sampling, and measurement of gaseous fuels, are now in process of preparation or have been prepared as tentatives. All of these, it is expected, will be utilized extensively by our Laboratories. A definite need for these methods has been felt to exist for some time and Committee D-3 and its subcommitttees have been devoting a great deal of time and energy to their preparation.

Standards on Petroleum Products

One of the most widely distributed A.S.T.M. publications, D-2's compilation of Standards on Petroleum Products, is now off press. The book contains all of the many standards used extensively by those in the petroleum field to determine properties and quality and performance characteristics by carefully developed testing methods.

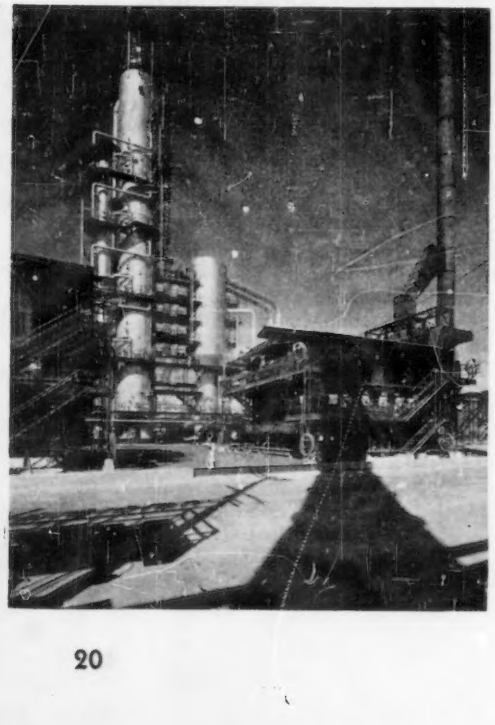
Including much new material, the 1949 edition gives the latest approved form of 105 test methods, 11 specifications, two lists of definitions of petroleum and Rheological Properties Terms, and a recommended practice for designating significant figures in specified limiting values.

Also its several appendices include:

Determination of Micro Cone Penetration of Lubricating Grease; Apparent Viscosity of Lubricating Greases; Definitions, Functions, Types, and Designations of Cutting Fluids; Carburetor Jacket for Use with Motor and Research Methods to Rate High Vapor Pressure Fuels; Determination of Color Index of Petroleum Products by Photoelectric Colorimeter; Sulfur in Petroleum Products by the CO_2-O_2 Lamp Method; Boiling Point Range of Polymerization Grade Butadiene; Phosphorus in Lubricating Oils, Lubricating Oil Additives and Their Concentrates; Bromine Number of Petroleum Distillates (Color Indicator Method and Electrometric Method); and Measuring Temperature of Petroleum and Petroleum Products.

Recommendations on the form of A.S.T.M. Petroleum Products Testing Methods; a list of proposed methods prepared by Committee D-2 and published as information prior to 1949; and committee information and regulations are also included in the compilation.

Bound in heavy paper or cloth, 6 by 9 in., price is $5.50 ($4.25 to A.S.T.M. Members). For cloth, add 65 cents to each price.



G. A. Wilson—25 Years with A.S.T.M.

It is always a pleasure to record in these pages the completion of twenty-five years of service, and this is particularly true in the case of George A. Wilson, Assistant Editor, who celebrated twenty-five years with the Society on December 15.

A dinner was given in Mr. Wilson's honor by the staff to commemorate the occasion, at which he was presented with a sterling silver carving set, as a recognition by the Board of Directors.

Mr. Wilson received his technical training at Drexel Institute of Technology, which he supplemented by special studies to fit him for his editorial work. He has been an invaluable assistant in handling the many details involved in getting out the Society's publications, and he is recognized as quite an authority on the mechanics of printing. His editorial work for the most part is in connection with the technical papers, whether in the *Proceedings*, Bulletin, or Special Technical Publications, and many of these bear the mark of his work. But it is in the handling of some new and unusual problem that his aid is particularly sought. More recently, the members of the Society have gotten to know him as being responsible for many of the arrangements for Society meetings.

G. A. Wilson

Much of his success is due to his kindly equanimity and the unruffled manner in which he goes about his work. This has stood him in good stead in a position where the securing of cooperation is so vital.

Mr. Wilson's coming of age brings the total membership of the "Twenty-Five Year Club" to five, the others being J. K. Rittenhouse, C. L. Warwick, Marie A. Ounan, and R. E. Hess

Board Resolution Thanks West Coast General Arrangement Committee

RESOLVED,

That the Board of Directors of the American Society for Testing Materials expresses to the General Committee on Arrangements for the Pacific Area National Meeting, and to all its committees, its sincere appreciation of their splendid work in planning for the first Pacific Coast meeting of the Society held last October in San Francisco, and in carrying through all their plans to such successful fruition; and be it further

RESOLVED,

That the thanks of the Society be extended to all members of the committee concerned for their part in making this meeting the undoubted success that it was, and that a copy of this Resolution be sent to each member.'

—Adopted at the meeting of the Board of Directors on January 17, 1950.

Research for Management Discussed at Joint Meeting Sponsored by the Franklin Institute and Philadelphia District Council

SOME four hundred people attended the afternoon, dinner, and evening sessions at a meeting concerned with "Research for Management" sponsored by the Franklin Institute and the Philadelphia District Council, A.S.T.M., on Wednesday, December 14, 1949, held at the Institute.

The afternoon sessions covering the general topic "Facilities for Research" were under the chairmanship of Adolph O. Schaefer, Chairman, Philadelphia District Council, A.S.T.M. The first speaker was Milton Harris, President, Harris Associates, representating a viewpoint of the private or consulting research laboratory. A highlight in Mr. Harris' presentation was the statement that progress would be greatly accelerated by a more coordinated attack on technical problems by management and technologists, *i.e.*, teams are required but the first team must comprise these two groups and from many viewpoints, the formation of this team must precede the development of larger groups of scientists.

The next speaker was Harold K. Schilling, Head, Department of Physics, The Pennsylvania State College, who presented the basic reasons for the part that colleges and universities play in research, what type of projects are appropriate, and just what the minimum research budget should be. The project should be concerned with basic knowledge, suitable for educational purposes, and its results freely publishable. The schools need and use outside sources of funds. Mr. Schilling feels that the many industrial concerns without research staffs or facilities might well look to the university experiment stations and research institutes for expert help in specific problems of particular significance to the concerns.

The final speaker of the afternoon session was Edward R. Weidlein, Director, The Mellon Institute of Industrial Research, representing the nonprofit institutes, who spoke of the expanded position and importance of research today and that it is necessary for management thoroughly to understand the capital requirements of such research in relation to the final product. It can be stated, in general, he said, that 10 per cent over-all cost is needed for research, 25 per cent over-all cost to transfer laboratory work to the pilot plant stage, and, if this is successful, another 65 per cent over-all cost is necessary for commercialization. Dr. Weidlein believes the continued growth of research foundations is an indication that more and more research problems are being farmed out. Again it was emphasized that proper coordination was necessary to prevent a waste of funds.

The dinner session in Franklin Hall, following a cocktail hour, featured an address by Vice-Admiral Howard G. Bowen, U.S.N., Retired, Director of the Thomas Alva Edison Foundation, Inc., formerly Director of Office of Research and Invention, U. S. Navy, on "The Importance of Research." Richard T. Nalle, President, The Franklin Institute, presided. The keynote of Admiral Bowen's address was the vital relation of research to the rise and success of the modern industrial state and progress. He said, in conclusion, that a large proportion of our people do not know there is something more to industry than labor, management, financing, and marketing and the situation should be remedied before it is too late.

The evening session, under the chairmanship of Dr. Henry B. Allen, Executive Vice-President and Secretary of The Franklin Institute, covered the general topic of "Research in Industry," The first speaker of the evening was Dudley F. Chambers, Executive Engineer, Research Laboratories, General Electric Co., who spoke on some aspects of the function, organization, and operation of industrial, research, and developmental laboratories. The question of problems chosen should be left to the research director and, in turn, to the "exceptional research man" who must evaluate the opportunity for achieving results. Creative research people are rare and their ability should be used to the greatest possible degree, he said. G. H. Clamer, President, Ajax Metal Company, followed with a talk on research from the standpoint of smaller business enterprise citing six case histories occurring during his 50 years' experience with research. It is well, he added, that smaller enterprise look to the various facilities mentioned in the afternoon sessions for assistance with their research problems. W. F. G. Swann, Director, Bartol Research Foundation of The Franklin Institute, closed the evening session with a summary of the day's proceedings.

Officers of the new Ohio Valley District Council, a news article on which appeared in the December Bulletin. L. to r.: J. C. Harris, Chairman; J. H. Calbeck, Vice-Chairman; J. C. Pitzer, Secretary.

Canadian Paints and Pigments Testing Methods

THE Canadian Government Specifications Board has recently issued (November, 1949) a Schedule of Methods of Testing Paints and Pigments, and correspondence regarding this should be addressed to this Board in care of the National Research Council, Ottawa, Canada.

"The Schedule describes the general physical and chemical methods of testing paints and pigments for conformance with the specifications of the Canadian Government Specifications Board. It is intended to provide a uniform basis for testing procedures and thus eliminate divergence in numerical results arising from variations in the methods used. It is to be noted that reference to all A.S.T.M. methods shall mean to the latest revision unless otherwise specified."

Strength of Materials

Gerner A. Olsen

"Strength of Materials," by Mr. Olsen, Assistant Professor of Civil Engineering, City College of New York, is designed for use principally in technical institutes, college extension courses, trade schools, and colleges offering courses in strength of materials where calculus is not a needed or required subject.

Fundamental principles are presented with emphasis on practicality so that the student who wants to acquire a working knowledge beyond mere formula substitution may do so by following the clear, logical, and easily grasped methods.

The contents includes material covered under each chapter, as follows:

1. Important Principles of Mechanics Used in Strength of Materials;
2. Center of Gravity and Moment of Inertia;
3. Fundamental Stress and Strain Relationships;
4. Stresses in Thin-Walled Cylinders and Spheres, Riveted and Welded Joints;
5. Torsion;
6. Shear and Bending Moment Diagrams;
7. The Design of Beams;
8. The Deflections of Simple Beams;
9. Statically Indeterminate Beams;
10. Stresses Due to Eccentrically Applied Loads;
11. Columns;
12. Combined Stresses; and
13. Fatigue Strength—Stress Concentrations.

This 424-page book may be obtained from Prentice-Hall, Inc., 70 Fifth Ave., New York 11, N. Y., at $5.70 per copy.

Circular 476, Measurements of Radioactivity

SCIENTIFIC workers who are beginning research on problems of radioactivity and nuclear physics will find much valuable information compiled for their use in the new booklet published by the National Bureau of Standards.

It provides in convenient form most of the essential background for all phases of experimental investigations in these general fields. Chapters deal with such topics as detection and measurement of radioactive radiations, measurement of ionization currents, radioactive substances, equipment for producing artificially radioactive isotopes, radioactive radiations, radioactive tracers, radioactive standards and units, radioactivity in geology, and health protection.

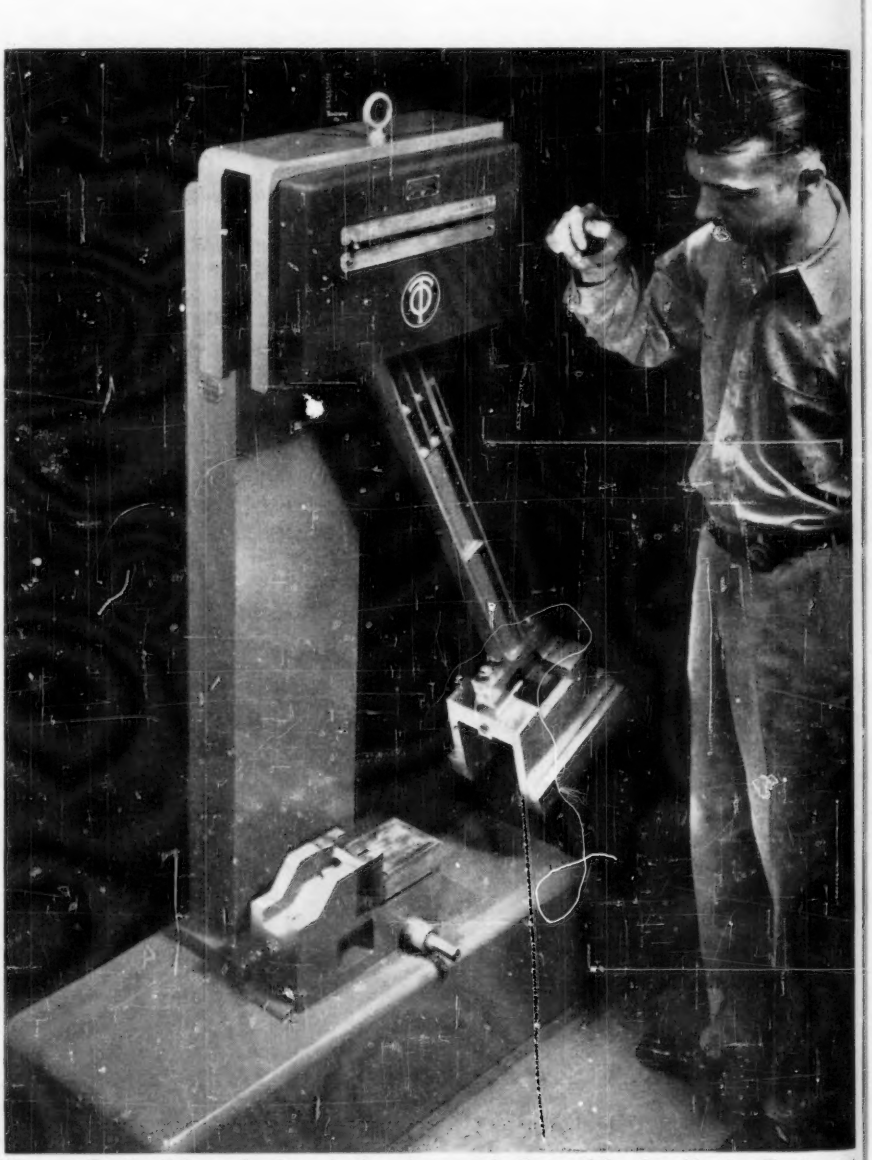
By Leon F. Curtiss, with 84 large double-column pages, illustrated, 35 cents a copy, the booklet is available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

Hot Tinning

A 112-page practical manual, *Hot Tinning* by W. E. Hoare, compiled primarily to meet the needs of operative tinners, foremen, and design engineers has been published by the Tin Research Institute, Inc. Considerable attention is devoted to plant requirements and useful hints on plant layout are provided. The procedures and solutions used for cleaning, pickling, and fluxing ferrous and non-ferrous metals in preparation for the actual hot-dipping operation are fully dealt with. The dip-tinning operation in its various forms is described in extensive detail for steel, cast iron, copper, and other metals in both pure tin and in tin-lead alloys. Methods of minimizing the contamination of tinning baths, for the cleaning and maintenance of the baths, and for the disposal of residues are covered.

The booklet concludes with a chapter on the examination and testing of useful data and conversion factors. It contains an adequate bibliography and is illustrated by numerous diagrams, flow sheets, and plant photographs.

This publication is obtainable from Tin Research Institute, Inc., 492 West Sixth Avenue, Columbus 1, Ohio.



"Impact Testing" Second prize-winning photograph, General Section, Testing Equipment Group, in the Sixth A.S.T.M. Photographic Exhibit, by William W. C. Wilke, Jr., Crane Co.

TECHNICAL COMMITTEE NOTES

Activities in the Field of Laboratory Apparatus

THERE is renewed interest in the technical committee work on laboratory apparatus as evidenced by two days of meetings held at the National Bureau of Standards on December 6 and 7 during which meetings were held of the following four subcommittees of Committee E-1 on Methods of Testing:

17 on Thermometers
18 on Hydrometers
19 on Glassware Laboratory Apparatus
21 on Metalware Laboratory Apparatus

The first day was devoted to consideration of a number of matters concerning A.S.T.M. thermometers. The committee reviewed final proof of the revised Standard Specifications for A.S.T.M. Thermometers in which a number of changes were made this year in order to eliminate a number of manufacturing inconsistencies. The committee also gave a final review to the new Methods of Testing and Standardization of Etched Stem Liquid-in-Glass Thermometers (E 77 – 49 T) which are being issued as tentative this year.

Action was taken to submit to letter ballot new tentative specifications for the A.S.T.M. stability test of soluble nitrocellulose thermometer 26 C. A set of precision testing thermometers has been completed and will be sent to letter ballot review of the committee. Draft specifications for a thermometer for the boiling point range of butadiene was completed for publication as information. Several other matters concerning important details in the manufacture of thermometers were referred to task groups for study.

The Subcommittee on Laboratory Glassware Apparatus considered the need for simplified procedures for testing burets and pipets, both gravimetrically and volumetrically. The demand for such methods has been particularly felt in Governmental laboratories. Consideration was also given to difficulties experienced in testing pear-shaped centrifuge tubes specified in the A.S.T.M. Method of Test for Water and Sediment in Petroleum Products by Means of Centrifuge (D 96 – 47 T). It is planned to undertake a study of this project in cooperation with Committee D-2 on Petroleum Products and Lubricants. A task group is to be appointed to standardize the terms and symbols used in designating porosity of fritted filterware.

The Subcommittee on Hydrometers decided on a program of work which will include the preparation of more detailed specifications for hydrometers, and also arrangements for the more permanent fixing of hydrometer scales to prevent slipping.

The Subcommittee on Metalware Apparatus elected as its new chairman, Ernest L. Ruh, Standard Oil Development Co. At the request of the thermometer subcommittee, a study will be made of ferrules for thermometers used with the Tag closed tester. It has been found that those being made are not interchangeable. This suggested the possibility of ferrule standardization for thermometers in all A.S.T.M. testing. This subcommittee plans to cooperate closely with other A.S.T.M. committees in reviewing requirements for metalware apparatus included in

A.S.T.M. Committee Week

Hotel William Penn, Pittsburgh, Pa. February 27–March 3, inclusive

Details will be furnished all committee members soon.
Hotel reservation forms will be sent.

Preliminary list of participating committees:

A-3 on Cast Iron
A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys
B-2 on Non-Ferrous Metals and Alloys
B-3 on Corrosion of Non-Ferrous Metals and Alloys
B-6 on Die-Cast Metals and Alloys
B-7 on Light Metals and Alloys, Cast and Wrought
B-8 on Electrodeposited Metallic Coatings
C-1 on Cement
C-7 on Lime
C-8 on Refractories
C-9 on Concrete and Concrete Aggregates
C-16 on Thermal Insulating Materials
C-21 on Whitewares
C-22 on Porcelain Enamel
D-1 on Paint, Varnish, Lacquer, and Related Products
D-3 on Gaseous Fuels
D-4 on Road and Paving Materials
D-5 on Coal and Coke
D-8 on Bituminous Waterproofing and Roofing Materials
D-11 on Rubber and Rubber-Like Materials
D-16 on Industrial Aromatic Hydrocarbons
D-18 on Soils for Engineering Purposes
D-19 on Industrial Water
E-1 on Methods of Testing
E-4 on Metallography
E-5 on Fire Tests of Materials and Construction
E-9 on Fatigue
E-12 on Appearance

new and revised A.S.T.M. methods. It also plans to cooperate with the Scientific Apparatus Makers of America on any problems experienced in connection with laboratory equipment manufactured for use with A.S.T.M. methods. This subcommiteee will also assist Committee E-3 on Chemical Analysis of Metals in the preparation of performance specifications for chemical balances.

Committee D-20 on Plastics

COMMITTEE D-20 on Plastics held its fall meeting in New York City, N. Y., on October 31 and November 1. The meeting of the main committee was preceded by meetings of its 10 subcommittees. Considerable progress was made at this meeting on a number of projects under study in the committee.

The subcommittee on optical properties presented for letter ballot committee vote a revised method for the measurement of luminous reflectance and transmission characteristics of plastic materials. The subcommittee on molds and molding processes submitted for committee vote an alternate design for injection molding of test specimens of thermoplastic compounds. Revisions were also presented in the Tentative Methods of Conditioning Plastics and Electrical Insulating Materials for Testing (D 618 – 49 T).

The meeting was concluded by a papers session arranged by the D-20 subcommittee on research at which the following four papers were presented:

"The Use of Electrical Measurements in the Study of Physical Properties of Plasticized Polyvinyl Resins," by A. J. Warner, Federal Telecommunications Laboratories.

"An Investigation of the Fatigue Behavior of Polystyrene," by Joseph F. Throop, Rensselaer Polytechnic Institute.

"Some Fundamentals of the Injection Molding Process," by Gerald L. Gilmore, Dow Chemical Co.

"Some Instruments for Measuring the Dynamic Mechanical Properties of Plastic Materials," by L. E. Nielsen, Monsanta Chemical Co.

Committee D-9 on Electrical Insulating Materials

MAKING considerable progress on a number of projects, Committee D-9 on Electrical Insulating Materials held a three-day series of meetings in Washington on November 28 to 30. In addition to the main committee meeting, meetings were held of 10 subcommittees and 15 of their sections.

A very complete review is being made by the committee of its electrical test methods. At the June meeting the committee presented the first results of this work in the form of completely revised methods for electrical resistance (D 257 – 49 T). The methods for power factor and dielectric strength will be extensively revised upon completion of the current work. The test for arc resistance revised in 1948 is being studied further.

The Subcommittee on Ceramic Products recommended the adoption as standard of the Tentative Specifications for Low and Medium Voltage Pin-Type Lime-Glass Insulators (D 730 – 46 T) and for Communication and Signal Pin-Type Lime-Glass Insulators (D 879 – 46 T). This subcommittee also completed new tentative methods of testing glass-bonded mica used as electrical insulation.

New specifications for absorbent laminating paper for electrical use were approved by vote of the committee and will shortly be issued as tentative. Specifications for electrical insulating paper, interlayer type, are in preparation. Three new methods of test have been completed covering determinations of water-soluble matter, alcohol-soluble matter, and soluble sulfates in paper.

An extensive revision of Standard Specifications D 351 in the form of new Tentative Specifications for Natural Muscovite Mica Based on Visual Quality Control has been approved by committee vote and will shortly be issued as tentative. The procedure for power factor and dielectric constant in Specifications D 351 will be issued as tentative under a separate designation.

Electrical-Heating Alloy Committee Enlarge Scope

AT THE meeting of Committee B-4 on Electrical Heating, Resistance and Related Alloys, held in New York on November 2, Section C on Tungsten Wire of Subcommittee VIII on Metallic Materials for Radio Tubes and Incandescent Lamps agreed to change the scope of its activity. This new scope now includes methods and standards for tungsten wires from 0.020 in. in diameter down to and including submill sizes. The seventeen following companies have expressed interest in this activity:

RCA Victor Division of Radio Corp. of America
Western Electric Co.
Westinghouse Electric Corp.
North American Phillips Co., Inc.
Radiant Lamp Corp.
Sylvania Electric Products, Inc.
Thermionic Products
Cleveland Tungsten Inc.
Tung-Sol Lamp Works, Inc.
Federal Telecommunication Labs., Inc.
Secon Metals Corp.
General Electric Co.
Sigmund Cohen Corp.
American Tungsten Corp.
Scott Testers, Inc.
Bell Telephone Labs., Inc.
Hytron Radio and Electronic Corp.

However, it is hoped that there will be an even wider interest at the next meeting, which will be held in February, and that all those interested will try to attend.

At its first meeting the group discussed the following matters pertaining to fine tungsten wires:

1. The standardization of methods for determining wire size.
2. Tensile testing equipment for fine tungsten wires.
3. Sag and straightness measurement.
4. Definition for and methods for examining the surface and volume characteristics of fine tungsten wires.

Anyone interested in attending the next meeting should contact F. J. Biondi, Bell Telephone Labs., Inc., Murray Hill, or H. A. DeVincentis, Sylvania Electric Products, Inc., Bayside, Long Island, N. Y.

Officers of Committee D-9 on Electrical Insulating Materials: L. to r. C. T. Hatcher, Chairman; E. A. Snyder, Vice-Chairman; H. A. Eysenbach Membership Secretary; O. E. Anderson, Recording Secretary.

Joint Committee on Effect of Temperature on Metals Has Active Program

Technical Symposiums and Papers Being Developed; Research Projects Under Way in Joint A.S.T.M.-A.S.M.E. Committee

IN ORDER more effectively to carry out its various activities the Joint Committee on Effect of Temperature on the Properties of Metals, which functions under the auspices of the American Society for Testing Materials and The American Society of Mechanical Engineers, has virtually completed reorganization of its subcommittees and personnel. This group, always very active in sponsoring technical papers and symposiums, has several papers and reports under way including two symposiums, one covering "The Effect of Sigma Phase on the Properties of Metals at Elevated Temperatures," the other dealing with "The Corrosion of Gas Turbine Materials." These symposiums will each include eight to ten papers, and are scheduled for presentation at the A.S.T.M. Annual Meeting in Atlantic City the week of June 26, 1950.

Personnel:

The Committee is headed by Ernest L. Robinson, Structural Engineer, Turbine Engineering Divisions, General Electric Co., Schenectady, N. Y., with Howard C. Cross, Battelle Memorial Institute, Columbus, Ohio, Secretary; Francis B. Foley is the Vice-Chairman; and serving with these three officers as the Executive Committee are Past-Chairman Norman L. Mochel, Manager, Metallurgical Engineering, Westinghouse Electric Corp., Philadelphia, Pa., and A. J. Herzig, Chief Metallurgist Climax Molybdenum Co., Detroit, Mich. The Panels and Subcommittees of this joint group are as shown—each Panel includes from 6 to 25 men who are leaders in the specific fields covered in the panel work.

Activities:

The scope of this Committee is as follows: "To sponsor investigations leading to the accumulation, evaluation, and dissemination of data on the engineering properties of metals at high and low temperatures and the standardization of test methods pertaining thereto."

While a great portion of the committee work has involved research, two existing standards are included in its responsibilities covering Recommended Practices for Short-Time Elevated-Temperature Tension Tests and Long-Time Creep Tests. Other proposed standards are being developed including one for stress rupture tests of metallic materials. Two extensive research investigations are currently under way under the committee auspices. One on the effect of variables on the creep resistance of steels includes studies currently of major interest on the effect of varying silicon-aluminum ratios (Project 18). Certain phases of graphitization of steels are being studied in Project 29 with long-time aging tests and carbide extraction studies, particularly to ascertain the role of aluminum, under way. A progress report on this work is expected in June, 1950.

The Joint Committee is sponsoring the publication by A.S.T.M. of a comprehensive series of data and curves covering the high-temperature creep and rupture strengths of wrought steels including many of the highly alloyed and austenitic varieties. Compiled by J. J. Heger and R. F. Miller, Carnegie-Illinois Steel Corp., the book should go a long way toward answering persistent demands for authoritative information on many of the steels that have come into widespread use, particularly in recent years. Development of similar data on castings is under way.

The "Effect of Structural Changes on the Properties of Ferritic and Austenitic Steels" will be the subject of two technical papers now being prepared. A bibliography covering "Heat Embrittlement" is to be brought up to date. The committee hopes to sponsor a 3-year summary of the intensive studies recently carried out on the graphitization problem. Other work, particularly of interest to the Steam Power group, involves thermal shock and distortion, and design factors such as Poisson's ratio, and the modulus of elasticity. Data and bibliography will also be compiled on "Coefficient of Thermal Expansion."

A technical paper is to be developed covering "The Use of Austenitic Steels in the Petroleum Industry."

The Aviation Panel has some important studies including a "Statistical Evaluation and Analysis of Some Airframe Sheet Materials" and this group is also studying sheet materials for power-plant applications. The group concerned with Gas Turbine problems is completing its Recommended Practice for Conducting Stress Rupture Tests at High Temperature and is studying high-temperature stress rupture and fatigue of notched test bars.

This panel is investigating the corrosion of metal by various oil ashes and methods of protecting the different alloys. It is sponsoring the Symposium on Corrosion-Erosion of Gas Turbine Materials. A technical paper is being developed on statistical analysis using as a basis data from an extensive program of stress rupture tests.

The group concerned with General Research is sponsoring the Symposium on the Effect of Sigma Phase. It is considering various methods of making and reporting creep tests, and the panel will develop further information on the effect of surrounding atmospheres on the creep properties of materials.

This Joint Committee has to its credit a number of important accomplishments down through the years, perhaps particularly outstanding the 1931 Symposium on Effect of Temperature on Metals, the 1938 Volume on Creep Data, the 1941 Report on Impact Resistance and Tensile Properties of Metals at Subatmospheric Temperatures, and the 1946 Symposium on Materials for Gas Turbines.

Finance	N. L. Mochel, *Chairman*
Aviation	Leo Schapiro, Douglas Aircraft Co., Santa Monica, Calif., *Chairman*
Data and Publications	R. F. Miller, Carnegie-Illinois Steel Corp., Pittsburgh, Pa., *Chairman*
Gas Turbine	C. T. Evans, Jr., Elliott Co., Jeannette, Pa., *Chairman*
General Research	A. J. Herzig, *Chairman*
Papers and Meetings	H. C. Cross, *Chairman*
Petroleum and Chemical	C. L. Clark, Timken Roller Bearing Co., Steel & Tube Div., Canton, Ohio, *Chairman*
Steam Power	N. L. Mochel, *Chairman*
Project 18. Effect of Manufacturing Variables on the Creep Properties of Steel	H. C. Cross, *Chairman*
Project 29. Stability of Steels as Affected by Temperature	J. J. Kanter, Crane Co., Chicago, Ill., *Chairman*

New Projects Discussed at Acoustical Materials Committee Meeting

MANY interesting problems peculiar to the acoustical materials field were discussed at a meeting of Committee C-20 on Acoustical Materials—its first meeting since its organization last May at the Hotel Chase, St. Louis, Mo.,—on November 15. This meeting was held in advance of the fall meeting of the Acoustical Society of America with a very good attendance of respective sections of the industry. The greater portion of the day was devoted to meetings of the five subcommittees which have now been organized followed by a short session of the entire committee.

This being the first meeting of each of the subcommittees, the time was given to discussion of initial projects which were felt to be of most importance to the industry for early development. Subcommittee I on Sound Absorption under the chairmanship of Hale Sabine, will concentrate initially on methods of tests. The development of a standard reverberation chamber test was felt to be most important and action was taken to initiate round-robin tests to be carried on among six laboratories to collect data which will be helpful to offset existing discrepancies among reverberation chambers both here and abroad. These tests will be supplemented by impedance tube measurements. An adaption of the box method as a small scale test will be written up for consideration as a comparison method. Work will also be undertaken on impedance tube methods as well as performance tests on completed installations to measure the efficiency of materials in place. Several task groups were authorized to conduct these several projects. In the meeting of Subcommittee II on Fire Resistance, W. Waterfall, Chairman, it was pointed out that no existing or accepted test methods or data are available. It was felt that a small scale test is needed. All existing data will be reviewed by a task group and close coordination with Committee E-5 is to be effected.

Subcommittee III on Maintenance, P. Chrzanowski, Chairman, approved a scope reading as follows: The development of test methods, recommended practices and specifications to evaluate procedures and practices designed to prolong the appearance and the acoustical life of installations. There was considerable discussion on the problem of paintability and a task group was appointed to develop a project. The related subject of breathing and surface deposition causing discoloration was also discussed and a task group appointed to consider this along with establishing a definition of the term "breathing." Subcommittee IV on Application, L. F. Yerges acting as Chairman in the absence of B. L. Smith, Chairman, reviewed the several types of applications now in use. These were summed up into four types, namely adhesives, nail and screw, mechanical or floating (clips, T-rails, etc.), and plaster. It was suggested that a survey of the data be made on these four types. Subcommittee V on Other Physical Properties under the chairmanship of W. A. Jack, agreed that the title of the subcommittee should be changed to Basic Physical Properties. It was understood that the work of this committee would apply to those physical properties not covered by the other subcommittees. The problems considered to be of greatest interest were felt to be those pertaining to moisture absorption, dimensional stability, paintability, light reflection, thermal insulating properties (breathing tendencies), flow resistance, absorption, strength under special conditions, vibration of supporting structure, and effect of water (warping, swelling, etc.). Task groups were authorized for initiating work on light reflection and flow resistance.

It was not felt advisable at this time to include in the organization a subcommittee on research. The stimulation of research will be left in the hands of the Executive Subcommittee for the time being pending the initial efforts of the several subcommittees. The proposed by-laws for the committee have been approved by letter ballot and are now in effect. It is planned to hold the next meeting of the committee sometime next May at A.S.T.M. Headquarters.

Schiefer to Receive Smith Memorial Medal

HERBERT F. SCHIEFER, Physicist, Textiles Section, National Bureau of Standards, has been selected as the first recipient of the Harold DeWitt Smith Memorial Medal.

In memory of Dr. Smith, this award was created through the generosity of Fabric Research Laboratories, Inc., Boston, and is to be presented by A.S.T.M. Committee D-13 for outstanding achievement in the science of the utilization of textile fibers. Details of the Award were given in the March, 1949, ASTM BULLETIN.

Dr. Schiefer will receive the Medal at the March, 1950 Meeting of Committee D-13, to be held in New York City.

Dr. Schiefer received various degrees

Committee on Quality Control of Materials Making Progress

COMMITTEE E-11 on Quality Control of Materials held its Fall meeting at A.S.T.M. Headquarters on November 18. This was preceded by a meeting of the E-11 Advisory Committee on Thursday evening, November 17. It was reported at the meeting that excellent progress has been made in the completion of a new and up-to-date A.S.T.M. Manual on Quality Control of Materials. The first section of the new manual will bring up to date and replace the text of the present A.S.T.M. Manual on Presentation of Data. The second section will be devoted to the subject of presenting plus and minus limits of uncertainty of an observed average and will be a revision of Supplement A of the present manual. In like manner Section 3 on Control Chart Method of Analysis and Presentation of Data will replace the present Supplement B. All three sections are now out to letter ballot vote in Committee E-11 and after approval it is planned to present the manual to the Society for publication this year.

A very interesting report covering a survey of sampling provisions in A.S.T.M. standards was presented by a task group. It is hoped that this report may be available for subsequent publication in the BULLETIN.

Another task group reported preparation of proposed recommendations on planning interlaboratory test programs.

A progress report was received from the task group studying the problem of determining number of tests required for a desired precision of a sample average.

New task groups are being established on bulk sampling, curve fitting, and on precision and accuracy, the latter to include nomenclature and definitions of terms.

from the University of Michigan where he taught for several years. He has been at the Bureau since 1929. His achievements in the field of textile fibers have included notable contributions to the fundamental knowledge of fibers and fabric structures. His most recent work has been on abrasion and wear testing.

In 1945 Dr. Schiefer served as Scientific Consultant, Foreign Economic Administration, and was a member of a team which visited Germany to investigate research and test methods. A condensed report by Schiefer, Kropf, and Fourt was published in the January, 1947 ASTM BULLETIN. An important area of his work which has not been widely publicized is in connection with the Quartermaster Corps development of textiles for military use. Dr. Schiefer has had several honorary awards.

Concrete Pipe Committee to Review Standards

MUCH was accomplished at a meeting of Committee C-13 on Concrete Pipe held at the Hotel Statler, St. Louis, on November 17, 1949. This was due to both a well-planned agenda and to a good representative attendance of producers and consumers. Because the committee had not held a full meeting since May, 1946, considerable discussion took place in reviewing the existing standards on concrete pipe based on comments submitted. In general this review revolved around the necessity for complete revision of existing standards instead of partial revision.

As a result of the deliberations at the meeting several temporary subcommittees or task groups were organized. These subcommittees will be concerned with the immediate task of studying the existing specifications, on the basis of making partial revisions, in line with those discussed at the meeting. Subcommittees were formed to study (1) clarification and revision of the three-edge bearing test; (2) extra-strength or triple-strength nonreinforced concrete pipe 12 in. to 24 in. in diameter; (3) reinforcing to conform to the simplified standards and providing provision for adequate welding; (4) review and revision of the absorption test; (5) revision of the provisions for types of cement; and (6) a coordinating subcommittee for the above projects.

Several matters of a broad nature such as the elimination of the sand bearing test, adaptation of existing test methods to pipe in excess of 72 in. and significance of data on load to produce 0.01 in. crack as compared with the ultimate load were discussed and considered as research projects of a long-range nature. In order to inaugurate such consideration, a steering committee was formed under the chairmanship of E. F. Kelley. The committee will plan to meet some time in the spring at which time it is hoped to have reports from the several task groups concerned with partial revisions recommending changes which after acceptance by the committee can be presented to the Society.

Spectroscopy Society to Meet

FOLLOWING a 6:00 p.m., nonreservation dinner at Tosca's, 118 Fulton St., the Society for Applied Spectroscopy will meet at the Socony Vacuum Training Center, 63 Park Row, New York, on Tuesday, February 7, 1950, at 8:00 p.m.

Milton Green, Isidore Adler, Harry Hausdorff, R. Hoffman, and Neil Gordon will all speak on pertinent subjects contributed as papers by Society members.

For some time the Society for Applied Spectroscopy and A.S.T.M. have had a Joint Committee on Nomenclature in Applied Spectroscopy. B. F. Scribner and Mary Warga, Chairman and Secretary, respectively, of A.S.T.M. Committee E-2 on Emission Spectroscopy are also A.S.T.M. representatives on this Joint Committee. (Along with that of E-2's Vice-Chairman, E. B. Ashcraft, the photographs of these two committee officers appear below.)

Committee E-2 on Emission Spectroscopy L. to r., B. F. Scribner, Chairman; E. B. Ashcraft, Vice-Chairman, Mary E. Warga, Secretary

1950 Convention of the American Concrete Institute

ANNOUNCEMENT has been received of the tentative program for the 46th Annual Convention of the American Concrete Institute to be held at the Edgewater Beach Hotel, Chicago, Illinois, February 20–22, 1950. Seven sessions are planned covering the subjects of inspection, ACI Building Code studies, reinforced concrete design problems, structural design of concrete pavements, admixtures for concrete, a panel discussion of questions on concrete problems and the annual open session on concrete and cement research. Precast and prestressed reinforced concrete is receiving considerable attention in its various problems which will be discussed by several of the committees in these sessions. The annual open session on research will feature reports on progress in cement and concrete studies throughout the country. C. H. Scholer, Kansas State College, will preside at the panel discussion of questions on concrete problems. President H. J. Gilkey, Iowa State College, will be the presiding officer at the convention.

Calendar of Society Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS—Annual Meeting, January 17–19, 1950, New York, N. Y.

SOCIETY FOR APPLIED SPECTROSCOPY—February 7, Socony Vacuum Training Center, New York, N. Y.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS—Annual Meeting, February 12–16, Pennsylvania (Statler) Hotel, New York, N. Y.

PITTSBURGH CONFERENCE ON ANALYTICAL CHEMISTRY AND APPLIED SPECTROSCOPY—February 15–17, Hotel William Penn, Pittsburgh, Pa.

AMERICAN CONCRETE INSTITUTE—Convention, Week of February 20, Chicago, Ill.

American Society for Testing Materials—Committee Week, February 27–March 3 Hotel William Penn, Pittsburgh, Pa.

INTER-SOCIETY COLOR COUNCIL—Annual Meeting, March 8, Hotel Statler, New York, N. Y.

AMERICAN RAILWAY ENGINEERING ASSOCIATION—Annual Meeting, March 14–16, Palmer House, Chicago, Ill.

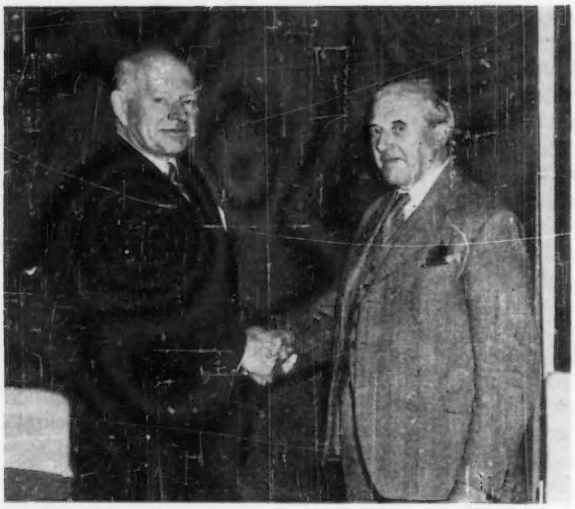
STEEL FOUNDERS' SOCIETY OF AMERICA—Annual Meeting, March 21–22, Edgewater Beach Hotel, Chicago, Ill.

AMERICAN CHEMICAL SOCIETY—National Meeting (Divided), March 26–30, Houston, Tex.; April 9–13, Philadelphia, Pa.; April 16–20, Detroit, Mich.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS—Spring Meeting, Week of April 10, Hotel Statler, Washington, D. C.

AMERICAN FOUNDRYMEN'S SOCIETY—54th Annual Convention and Exhibit, May 8–12, Public Auditorium, Cleveland, Ohio.

American Society for Testing Materials—53rd Annual Meeting and 9th Exhibit of Testing Apparatus and Related Equipment, June 26–30, Hotel Chalfonte-Haddon Hall, Atlantic City, N. J.



Left: A.S.T.M. President James G. Morrow, shaking hands with E. A. Evans, President of The Institute of Petroleum (Great Britain), who attended the Pacific Area Meeting.

Dr. E. A. Evans, of England, a Visitor

THE Society was honored on the occasion of its meeting in San Francisco last fall, with the presence of Dr. E. A. Evans, distinguished president of the Institute of Petroleum in Great Britain. Doctor Evans happily found it possible to accept the Society's invitation to attend the meeting and to participate in various technical and social activities. He was able so to arrange his itinerary in this country as to spend the entire week of the meeting in San Francisco, making the acquaintance of many of the officers and members of the Society and winning affection and admiration from all.

Perhaps the high light of his visit was his interesting informal talk as guest speaker at the Petroleum Industry Luncheon, where his charm and eloquence pleased a responsive audience. He contributed importantly to the discussion in the two technical sessions on high-additive content oils and turbine oils, and participated in a number of the sessions of Committee D-2 on Petroleum Products and Lubricants. His visit has served further to cement the cooperative relations of long standing between the Institute and A.S.T.M., which are substantially promoting important technical developments in the petroleum industries of Great Britain and our country.

A further interesting international "flavor" attended the meeting of Doctor Evans with the President of the Society, James G. Morrow—our first president from our northern neighbor, Canada. Mr. Morrow's long association with Canadian standardization activities and his recent visits to England and the continent, furnished many interesting topics of conversation with Doctor Evans. The two men spent several hours together on the Thursday evening boat ride on San Francisco Bay, subsequently adjourning to the Fairmont Hotel when the accompanying "hands across the sea" photograph was taken.

We send our hearty greetings to Doctor Evans and the Institute of Petroleum, and hope to have the pleasure of greeting him here again.

British Methods for Testing Petroleum and Its Products

COPIES of the 10th edition (1949) of "Standard Methods for Testing Petroleum and Its Products," published by the British Institute of Petroleum, have been received at A.S.T.M. Headquarters, and those interested can procure copies of the publication by writing to the Society. The book sells at $6.25, postage prepaid. The Institute and A.S.T.M. Committee D-2 on Petroleum Products and Lubricants cooperate closely in many activities, and this year Mr. E. A. Evans, President of the Institute and Chairman of its Standardization Committee, visited this country and attended the first Pacific Area National Meeting in San Francisco, being the guest speaker at the Petroleum Luncheon. Previous to this, various A.S.T.M. members had visited England making contacts and discussing various phases of A.S.T.M. work.

A description of the new British publication follows:

TWENTY-FIVE years ago the Institute of Petroleum (then the Institution of Petroleum Technologists) published the first edition of its "Standard Methods for Testing Petroleum and Its Products." This was a volume of 102 pages, describing some forty methods of testing petroleum products.

Throughout the intervening years, much work has been carried out on the subject of testing petroleum. In addition, new products have been brought into being and new applications have demanded the formulation of special methods to determine the suitability of these products for specified purposes. The book has now grown to 660 pages, describing in detail the apparatus for and the procedure of 116 methods for determining physical and chemical properties of crude petroleum and its products. The properties for which tests are available are extremely wide in range.

Compared with the previous (1948) edition, there are numerous changes, and these are listed in the preliminary text of the book. The three new methods are of considerable importance. They are: (1) an engine method of testing heavy-duty lubricants in relation to ring-sticking, wear, and deposit accumulation; (2) a method for Research octane number of motor fuels; (3) a method of assessing the corrosive tendencies of cutting oils in contact with cast iron.

Various methods have been revised in detail, including calorific value (now known as heat of combustion), distillation, viscosity, etc., while many editorial amendments have been made to avoid ambiguity.

Copies are available from A.S.T.M. Headquarters at $6.25 each.

Chemistry and Allied Spectroscopy Conference

ON FEBRUARY 15 to 17, 1950, at the William Penn Hotel, Pittsburgh, Pa., a merged conference of the Fifth Annual Analytical Symposium of the Analytical Division of American Chemical Society and the Tenth Annual Conference on Applied Spectroscopy of the Pittsburgh Spectroscopy Society will take place.

Comprehensive coverage of chemical and spectrographic subjects is planned by presentation of invited papers from outstanding proponents of the two fields.

Sometime during this same week, in Pittsburgh, A.S.T.M. Committee E-2 expects to meet. Many of the people active in the Spectroscopy Society of Pittsburgh are also active members of E-2.

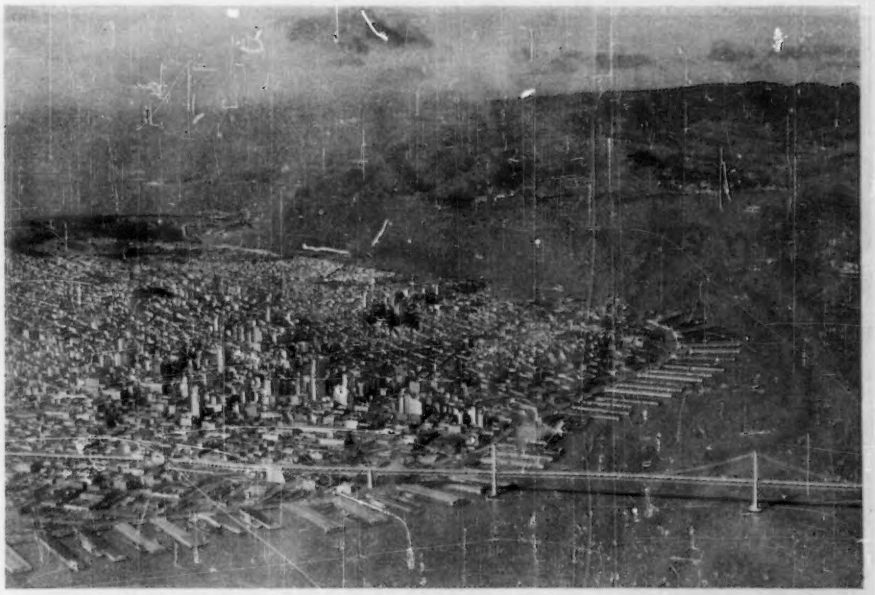
Also an organization meeting for a new A.S.T.M. Committee on Absorption Spectroscopy probably will take place during this week.

Circular 477, Testing of Hydrometers

To IMPROVE the usefulness of hydrometers and to facilitate their testing on a uniform basis, Elmer L. Peffer and Mary G. Blair, of the National Bureau of Standards, have just published a booklet which sets forth desirable features of design and construction.

The various scales commonly used for hydrometers are defined, and recommendations are given for subdividing and marking them. These scales include density, specific gravity, degrees Baumé, degrees API, percentage by weight, percentage by volume, percentage proof spirit, Brix, Balling, and others. The relations between some of the arbitrary scales and specific gravity are stated. In addition, the circular outlines the conditions that should be fulfilled by hydrometers submitted to the Bureau of Standards for test, the procedure used in testing hydrometers at the Bureau, and the form of certificates and reports issued as a result of these tests. Instructions and other helpful information about submitting hydrometers for test are given.

Containing 9 large double-column, illustrated pages, and selling for 10 cents a copy, the booklet is available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.



Airview of San Francisco showing Bay Bridge in the foreground, Golden Gate Bridge, upper left. For note on discussion of Pacific Area papers, many of which are to be published, see page 10.

High-Strength Ceramics for High-Temperature Use

RESULTS of recent tests at the National Bureau of Standards have shown that several ceramic bodies previously developed by the Bureau have marked superiority, in both strength and creep characteristics at 1800 F. and above, over the best available high-temperature metal alloys. Laboratory data indicate that these ceramic oxide bodies, especially designed for use in jet engines and gas turbines, possess special properties required at the elevated operating temperatures of these power plants.[1] An experimental gas turbine, using blades fabricated from the oxide body of the most promising strength and creep characteristics, has been operated successfully in the Cleveland Laboratory of the National Advisory Committee for Aeronautics.

The revolutionary developments during the past 30 years, particularly the last 10 years, in both design and efficiency of power plants have emphasized the need for materials of great strength and durability at very high temperatures. This is a natural consequence of the fact that, in any device for the conversion of heat energy into work, the efficiency of that device may be increased by increasing the temperature differential between the beginning and end of the conversion.

Because design engineers projected their plans into regions of temperature and stress far beyond the potentialities of known metallic alloys, a survey of nonmetallic compounds, especially the oxides, silicates, carbides, and related combinations peculiar to ceramics became necessary. As a consequence of this, the National Bureau of Standards developed six ceramics antibodies. Also a comprehensive investigation was begun at the Bureau on the high-temperature strength and creep in pure tension of these six oxide bodies. For test purposes specimens round in cross-section and approximately 0.3 in. in diameter throughout the gage length were prepared. The adapters for applying the stress were $8\frac{1}{2}$ in. long, $1\frac{3}{16}$ in. in diameter, and were made of one of the bodies under test. The strain gages, similar in design to those used at the National Bureau of Standards for measuring creep of metals, were fabricated from 90 per cent platinum, 10 per cent rhodium tubing, and wire. Four thermocouples mounted near the specimen provided temperature measurements. The specimens were heated in conventional wire-wound furnaces with periodic measurement of strain using a Gaertner extensometer-viewing microscope. Loads were applied to the specimen through a lever system.

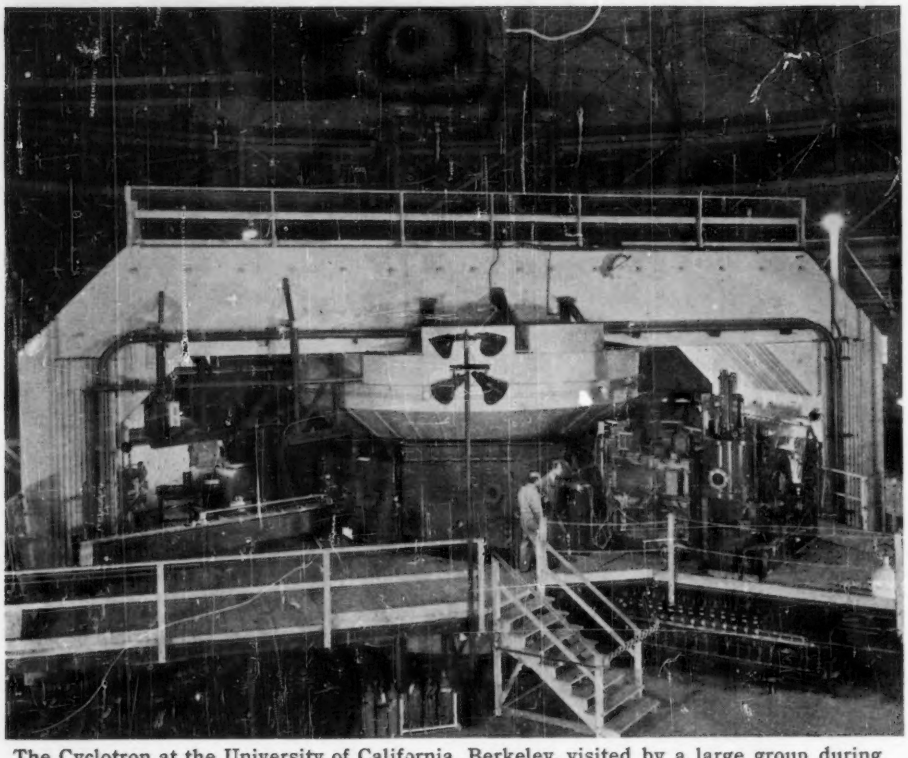
In general, each combination of stress and temperature was maintained for about 160 hr., or one week. Conditions were then changed by an increment of either stress or temperature, until failure, for a total of 109 tests.

Strengths in tension up to 18,000 psi. at 1800 F., and 15,000 psi. at 1900 F., were observed. Above 1900 F., however, the strengths dropped off rapidly to an average of about 5000 psi. at 2000 to 2200 F. Resistance to creep also decreased rapidly, for the particular porcelains tested, when temperatures were raised above the range 1800 to 1900 F. Results show that even the comparatively low stress of 6000 psi. has caused more than a ten-fold increase in the rate of creep at 2050 F. compared to the rate at 1800 F.—and the porcelains on which these tests were made are the most resistant to creep of any investigated. Maximum observed creep rates, for all of the bodies tested, may be summarized as ranging from about 0.0001 to 0.0002 per cent per hr. at 1700 F. for the range of stresses used; from 0.0002 to 0.0008 per cent per hr. at 1800 F. and a stress of 16,000 psi.; and from 0.0030 to 0.0040 per cent per hr. at 1900 F and 10,000 psi. stress. The maximum stress at rupture for the four N.B.S. ceramic bodies at various temperatures is given in Table I.

TABLE I.—STRESS-TEMPERATURE DATA ON FOUR HIGH-STRENGTH CERAMIC BODIES.

Temperature, Deg. Fahr.	MAXIMUM STRESS, TENSION, psi. ON N.B.S. CERAMIC BODIES			
	No. 358	No. 353	No. 151	No. 4811C
1500	13 000	13 000	12 000	14 000
1700	14 000	13 000	13 000	14 000
1800	17 000	18 000	18 000	18 000
1900	8 000	4 000	15 000	16 000
2100	...	...	...	6 000

[1] For complete technical details see "Strength and Creep Characteristics of Ceramic Bodies at Elevated Temperatures," by M. D. Burdick, R. E. Moreland, and R. F. Geller, N.A.C.A. Technical Note No. 1561, available from the National Advisory Committee for Aeronautics, Washington 25, D. C.



The Cyclotron at the University of California, Berkeley, visited by a large group during the Pacific Area National Meeting.

1950 Annual Meeting of Inter-Society Color Council

ON MARCH 8, 1950, in the Keystone Room, Hotel Statler, New York City, the 19th annual meeting of the Inter-Society Color Council will be held. Members of the Inter-Society Color Council's 19 member bodies are cordially invited to attend.

Committee discussions and business will be held in the morning. The afternoon session will be held under the title: Color as Used in Architecture, Design, and Decoration. The following speakers will present the color viewpoint of practicing members of his association:

Scott Wilson, American Designers' Institute
Waldron Faulkner, American Institute of Architects
Karl Bock, American Institute of Decorators
Egmont Arens, Society of Industrial Designers

A dinner meeting, "I.S.C.C. Operation Rainbow," is being arranged by Mrs. Helen D. Taylor's Committee. In the evening Ralph M. Evans will present one of his unusually fine illustrated lectures, "Seeing Light and Color."

For further information address the Inter-Society Color Council, Box 155, Benjamin Franklin Station, Washington 4, D. C.

Notes on Soldering

DURING recent years every detail of the soldering process has been scientifically investigated and a vast literature on the subject has accumulated. In a new edition of the British Tin Research Institute's handbook "Notes on Soldering," W. R. Lewis reviews these researches and presents a compilation of the more important facts which are likely to be of value to solder-users in a large variety of industries.

Advances in soldering technique, with particular reference to mass-production methods of assembly, are discussed and the various forms of solder and methods of applying heat to the joints are described in outline so that their principles may be easily discerned and readily adapted for any particular applications. The importance of design for soldering is emphasized.

The fundamental principles underlying the production of "wiped joints" in lead pipes are fully covered and alternative types of joint in lead pipe are described and illustrated.

Aluminum, stainless steel, cast-iron and other "difficult-to-solder" alloys are capable of being soldered by the special methods suggested.

The behavior of solders at various temperatures, under tensile and shear stresses, and under creep conditions, is important to the designer and to the production engineer, and data on these properties, together with notes on the metallurgical constitution of the tin-lead solders, are included.

"Notes on Soldering" also contains an adequate bibliography and a detailed scheme for the chemical analysis of tin-lead solders devised by J. W. Price.

This 88-page booklet, which is suitably illustrated with 47 photographs and diagrams, is available, free of charge, on application to Bruce Gonser, The Battelle Memorial Institute, 505 King Avenue, Columbus 1, Ohio, American representative of The Tin Research Institute.

Spanish-English Engineers' Dictionary

THE second edition of the "Engineers' Dictionary", Spanish-English and English-Spanish prepared by Louis A. Robb, has recently become available. This replaces the first edition which was printed in 1943 under war conditions when it was necessary to limit the number of pages used, and consequently to lay aside some available material. The book, however, did deal thoroughly with civil engineering.

In the new edition, the field covered is still engineering; however, terms of other sciences such as chemistry, geology, and metallurgy, as well as terms of finance, insurance, and transportation, that are regularly needed in connection with engineering work, are also included.

In enlarging the book, the principal objections have been:

1. To cover electrical and mechanical engineering much more thoroughly. Radio, of which the first edition had nothing, has been given thorough study. Important terms of television have been included.
2. To bring all branches of civil engineering up to date. Special attention has been given to photogrammetry, soil mechanics, and airport construction.
3. To include the important terms peculiar to mining, shipbuilding, logging, sugar milling, and oil-field operations.

Copies of this 664-page book can be obtained for $12.50 from John Wiley & Sons, Inc., New York 16, N. Y.

Error in Rolled Structural Steel Pamphlet Dated October, 1949

IN Tentative Specification A 113 – 49 aT for Structural Steel for Locomotives and Cars, an error has occurred in revising Table II on bend test requirements for printing in the October, 1949 issue of the special pamphlet "A.S.T.M. Specifications for Rolled Structural Steel."

The requirement in Table II now reading "Over ¾ to 1½, incl. . . . 1" should be broken down into lines to read as follows:

Over ¾ to 1, incl.	½
Over 1 to 1½, incl.	1

New Members to January 3, 1950

The following 65 members were elected from December 5, 1949, to January 3, 1950, making the total membership 6709.

Names are arranged alphabetically—company members first, then individuals.

Chicago District

CRAPPLE, GEORGE A., Director of Research, Wilson and Co., Inc., 4100 S. Ashland Ave., Chicago 9, Ill.

LESSIG, DONALD HORTON, Chief Engineer, D. H. Lessig, Engineers, Warsaw, Ind. For mail: 110½ E. Center St., Warsaw, Ind.

SMITH, PAUL S., Specifications Department Head, Motorola, Inc., 4545 Augusta Blvd., Chicago 51, Ill.

Cleveland District

MERCER, JERRY L., Metallurgist, The Frank L. Crobaugh Co., 1426 W. Third St., Cleveland 13, Ohio. For mail: 1423 Riverside Dr., Lakewood 7, Ohio.

Detroit District

CLARK, FRANK W., Chief Chemist, Chemical Lab., Consumers Power Co., Jackson, Mich.

EVERETT, FRANKLIN L., Associate Professor of Engineering Mechanics, University of Michigan, 411 W. Engineering Bldg., Ann Arbor, Mich.

GRAHAM, CARL F., Supervisor, Analytical Research, Wyandotte Chemicals Corp., Wyandotte, Mich.

HAVILAND, J. M., Chief Engineer, Haviland Products Co., 421 Ann St., N. W., Grand Rapids 2, Mich.

HOBBS, NORMAN L., Chief of Control, R. P. Scherer Corp., Gelatin Products Div., 9425 Grinnell Ave., Detroit 13, Mich.

New England District

[illegible]BBETS, FRID & PRENTICE, Victor A. Frid, Partner, 862 Asylum Ave., Hartford 5, Conn.

CAPEN, BERNARD H., Technical Superintendent, Tyer Rubber Co., 10 Railroad St., Andover, Mass.

RICHART, FRANK E., JR., Assistant Professor of Mechanical Engineering, Harvard University, Pierce Hall, Cambridge 38, Mass. For mail: 222 Lowell St., Lexington, Mass.

STURDEVANT, E. G., Chief Engineer, United States Rubber Co., Bristol Plant, Bristol, R. I.

New York District

BOYLE-MIDWAY, INC., Jack T. Hohnstine, Laboratory Director, 22 E. Fortieth St., New York 16, N. Y.

BECKWITH, OLIVER P., Chief, Product Engineering Labs., Alexander Smith and Sons Carpet Co., Yonkers, N. Y. For mail: 84 Magnolia Dr., Dobbs Ferry, N. Y.

HARANTHA, STEPHEN FRANK, 30-57 Thirty-second St., Long Island City 3, N. Y. [J]*

RAMAGE, FREDERICK R., Chemist, Latex Fiber Industries, Inc., Beaver Falls, N. Y.

REBURN, CHARLES E., Chief Engineer, Pepsi-Cola Co., 46-02 Fifth St., Long Island City, N. Y.

SPEAR, NORMAN H., Research Physicist, John B. Pierce Foundation, 290 Congress Ave., New Haven 11, Conn.

STAROS, ANTHONY, Chief, Prosthetic Testing and Development Lab., Prosthetic and Sensory Aids Service, Veterans Administration, 252 Seventh Ave., New York 1, N. Y. For mail: 299 Maryland Ave., Freeport, N. Y. [J]

THOMAS, BEAUMONT, Chief Chemist, Stebbins Engineering and Manufacturing Co., 363 Eastern Blvd., Watertown, N. Y.

VERO, ERIC N., Chemist, E. W. Saybolt and Co., 265 Bayway, Elizabeth, N. J. For mail: 107 W. Eighty-sixth St., New York 24, N. Y. [J]

Northern California District

FIBREBOARD PRODUCTS, INC., Howard S. Gardner, Director, Research and Development Div., Box MM, Antioch, Calif.

HILL, CLAIR A., Civil Engineer, Box 558, Redding, Calif.

Ohio Valley District

KOENIG, RODNEY J., Engineer in Training, State Highway Testing and Research Lab., 155 W. Woodruff, Columbus, Ohio. For mail: 160 Hanford St., Columbus 6, Ohio. [J]

Philadelphia District

BOLLMAN AND CO., INC., GEORGE W., M. J. Reider, Research Director, Adamstown, Pa.

KINGSTON TRAP ROCK CO., C. F. Mohr, Sales Engineer, Kingston, N. J.

BODMER, JAKOB E., Sun Physical Lab., Sun Oil Co., Bishop Hollow Rd., Newtown Square, Pa.

Pittsburgh District

HODGE, EDWIN S., Fellow, Department of Research in Chemical Physics, Mellon Institute of Industrial Research, Pittsburgh 13, Pa.

MCFEATERS, HARRY L., Chief Engineer, Pennsylvania Engineering Corp., New Castle, Pa.

MESSMER, JOSEPH H., Research Associate, Multiple Fellowship of Baugh and Sons Co., Mellon Institute of Industrial Research, 4400 Fifth Ave., Pittsburgh 13, Pa.

SAUEREISEN, C. FRED, President, Sauereisen Cements Co., 1045 N. Canal St., Pittsburgh 15, Pa.

St. Louis District

BLATTER, A. OSCAR, Chief Chemist, Union Electric Company of Missouri, 315 N. Twelfth St., St. Louis 1, Mo. For mail: 130 Roseacre Lane, Webster Groves 19, Mo.

MUELLER, FRANK H., Chief Products Engineer, Mueller Co., 512 W. Cerro Gordo, Decatur, Ill.

Southern California District

DELLINGER, I. S., Chief Chemist, Macmillan Petroleum Corp., 2020 Walnut Ave., Long Beach 6, Calif.

HOFFMAN, HARRY J., Chemist, Avery Adhesive Label Corp., 1616 S. California Ave., Monrovia, Calif.

Washington (D. C.) District

COLLINS AND SON, T. J., Samuel J. Collins, Owner, Box 449, Staunton, Va.

FUNKHOUSER CO., THE, K. F. Spence, Chief Engineer, Hagerstown, Md.

GRIMM, CLAYFORD T., Architectural Engineer, 4493 Quarles St., N. E., Washington 19, D. C. [J]

LORMAN, WILLIAM R., Materials Engineer, U. S. Naval Civil Engineering Lab., Solomons, Md.

RICHMOND, CITY OF, BUREAU OF PURCHASES, Henry L. Snellings, Jr., Buyer, Laurel and Main Sts., Richmond 20, Va.

WOODRUFF, PERCY W., JR., Laboratory Supervisor, The Erwin Cotton Mills Co., Durham, N. C.

Western New York-Ontario District

NUKEM PRODUCTS CORP., Walter R. Smith, Research Director, 111 Colgate Ave., Buffalo 20, N. Y.

MALLETT, M. B., Chief Engineer, English Electric Company of Canada, Ltd., George St., St. Catharines, Ont., Canada.

U. S. and Possessions

CELANESE CORPORATION OF AMERICA, H. K. Dice, Director of Research, Box 8, Clarkwood, Tex.

LONGVIEW LIME CORP., Warren Lewis, President, Mars Bldg., Birmingham 3, Ala.

To the A.S.T.M. Committee on Membership

1916 Race St., Philadelphia 3, Pa.

Gentlemen:

Please send me information on membership in A.S.T.M. and include a membership application blank

Signed _____

Address _____

Date _____ _____

ARNOLD, CECIL C., Consulting Engineer, 623 New World Life Bldg., Seattle 4, Wash.

BURNSIDE, BRADLEY ALLEN, Research and Development Manager, Timber Structures, Inc., Box 3782, Portland 8, Ore. For mail: 2826 N. E. Sandy Blvd., Portland 12, Ore.

CHANDLER, A. W., President, Refinery Manufacturing Co., 320 S. Kenosha St., Tulsa 3, Okla.

HYDE, SAM E., JR., Service Engineer, Cumberland Portland Cement Co., Chattanooga Bank Bldg., Chattanooga 2, Tenn.

LUM, RICHARD W. K., Civil Engineer, Territory Highway Dept., Honolulu, T. H. For mail: 3203 Winam Ave., Honolulu 41, T. H. [J]

MOOTY, ROBERT W., Assistant to Manager, Tennessee Coal, Iron and Railroad Co., 1508 Brown Marx Bldg., Birmingham 3, Ala.

PERKINS, KARL A., Chief Chemist, National Southern Products Corp., Twelfth Ave. at Fourteenth St., Tuscaloosa, Ala. For mail: 76 Springbrook, Tuscaloosa, Ala.

Other than U. S. Possessions

CANADIAN OIL COS., LTD., J. M. Allan, Chief Chemist, Box 600, Petrolia, Ont., Canada.

EMPRESAS VENEZOLANAS CONSTRUCTORAS C. A., Mario Gioyannini, Engineer, Ayenida Principal del Paraiso, 5, Caracas Venezuela.

FIAT GRANDI MOTORI, Giuseppe Simonetti, Director, Casella Postale 500, Torino, Italy.

QUEBEC IRON AND TITANIUM CORP., R. F. Driscoll, Purchasing Agent, 1255 Phillips Square, Montreal, P. Q., Canada.

AUSTRALIA, COMMONWEALTH EXPERIMENTAL BUILDING STATION, DEPARTMENT OF WORKS AND HOUSING, David V. Isaacs, Director, Box 30, Chatswood, N. S. W., Australia.

BOMBAY, UNIVERSITY OF, DEPARTMENT OF CHEMICAL TECHNOLOGY, LIBRARY, Director, Matunga Rd., Bombay 19, India.

FACULTAD NACIONAL DE MINAS, Apartado Aereo 1027, Nal. 47, Medellin, Colombia.

MANN, HELMUT O., Chief Metallurgist, Osnabrucker Kupfer-und Drahtwerk, (23) Osnabruck, Germany.

PAINT INDUSTRIES RESEARCH INST., Director, Howard College, Box 1525, Durban, South Africa.

RUBBER RESEARCH INSTITUTE OF MALAYA, THE, M. W. Philpott, Head of Chemical Div., Box No. 150, Kuala Lumpur, Malaya.

STOHR, J., Head, Technology Div., Commissariat a L'Energie Atomique, Service de Documentation, Fontenay-aux-Roses, Seine, France.

ZIGARAN, RAMON A. LOPEZ, Professor, Facultad de Ingenieria, Tucuman, Argentina. For mail: Pasaje Almirante Brown No. 1420, Tucuman, Argentina.

* [J] denotes Junior Member.

New Sustaining Members

WE ARE pleased to announce the acquisition of three Sustaining Memberships by three leading organizations during the last half of 1949. These three companies, Huron Portland Cement Co., Pennsylvania-Dixie Cement Corp., and Southern Pacific Co., have been active in A.S.T.M. for a number of years. In earlier 1949 BULLETINS announcement was made of Sustaining Memberships sponsored by Continental Oil Co., Dominion Bridge Co., Ltd., The Glenn L. Martin Co., and Mid-Continent Petroleum Corp. The official representatives of the three latest Sustaining Memberships are as follows:

Huron Portland Cement Co., Detroit, Mich.—P. H. Townsend, Vice-President and General Manager

Pennsylvania Dixie Cement Corp., Nazareth, Pa.—E. P. Newhard, Operating Manager

Southern Pacific Co., San Francisco, Calif.—Paul V. Garin, Engineer of Tests

At the present time there are over 215 A.S.T.M. Sustaining Members who through the payment of annual dues of $150 underwrite the Society's work to a degree somewhat more commensurate with the value to their wide-flung operations and their diverse interests of the A.S.T.M. work than would be the case with a straight Company Membership.

The Sustaining Members have the same privilege as do Company Members of designating different technically qualified individuals to serve on the various technical committees to which the companies may be elected. Each Sustaining Member receives a specially engrossed and distinctive membership certificate, and in addition to the regular A.S.T.M. publications the Sustaining Member may request a copy of any of the books which the Society issues. There is no entrance fee or transfer charge in the case of Sustaining Members.

A note to A.S.T.M. Headquarters will bring further information about some of the pertinent aspects of this class of Membership. The Board of Directors is appreciative of the interest and support of the companies which are A.S.T.M. Sustaining Members.

Republic Alloy Steels

PREPARED by the metallurgical staff of the Republic Steel Corp., this book is intended to supply fundamental and specific information on alloy steels, their production, testing, and use. The first eight chapters, covering some 200 pages, discuss fundamentals of alloy steel metallurgy, austenite transformation, alloying elements, hardenability, and give detailed charts of the mechanical properties including core properties and the effect of mass. One chapter which should be of much value discusses and shows typical steel microstructures—a metallographic atlas. Some 60 pages are devoted to metallurgical testing procedures and in this section frequent reference is made to A.S.T.M. standards. Auxiliary testing methods such as supersonics, magnetic particle, and X-rays are described. About 40 pages are devoted to industrial applications of alloy steels, with material arranged according to leading industries, and the book finally includes extensive tables of information and a glossary.

The illustrations are particularly well selected, the charts are clear and easily read, being printed over a color background, the whole book printed on coated stock. There is a detailed subject-index. Further information on the 384-page book can be obtained from the Republic Steel Corp., Cleveland 1, Ohio, by writing on company stationery.

To the A.S.T.M. Committee on Membership, 1916 Race St., Philadelphia 5, Pa.

Gentlemen:

Please send information on membership to the company or individual indicated below.

_____

_____

This company (or individual) interested in the following subjects: (indicate field of activity, that is, petroleum, steel, non-ferrous, etc.,)

_____

Signed _____

Date _____ Address _____

PERSONALS • • •

News items concerning the activities of our members will be welcomed for inclusion in the column.

Note—These "Personals" are arranged in order of alphabetical sequence of the names. Frequently two or more members may be referred to in the same note, in which case the first one named is used as a key letter. It is believed that this arrangement will facilitate reference to the news about members.

William D. Appel, head of the Textile Section of the National Bureau of Standards, has been elected a fellow of the Textile Research Institute. Dr. Appel is one of the first institute members to be honored with a fellowship. His work in the National Bureau of Standards has earned him a position of influence and leadership in the textile and the textile coloring industry. He is an expert on dying methods and the testing of dyes, particularly the action of light on dyed materials. Dr. Appel has been very active in the work of A.S.T.M., particularly its Committee D-13 on Textile Materials, where he is a member of the Advisory Committee and numerous other subgroups. He is Chairman of the important Subcommittee on Test Methods.

Leo G. Bargioni, for the last four years Assistant District Manager, Pittsburgh Testing Laboratory, San Francisco, Calif., is now associated with Super Concrete Emulsion, Ltd., manufacturers and distributors of concrete and masonry mortar additives, paints, etc. (of the same city). Prior to 1946 Mr. Bargioni was employed for 25 years by Smith, Emery & Co., in later years as Secretary-Manager. He is currently a member of A.S.T.M. Northern California District Council, and Chairman of the Membership Committee of that group.

William M. Barr, Research and Standards Consultant, Union Pacific Railroad Co., and for many years Chief Metallurgical and Chemical Engineer, retired as of January 1, 1950. A Past-President of A.S.T.M., Dr. Barr has had a notable record of activity and accomplishment in the Society, particularly in Committee A-1 on Steel, but also in other groups, notably Committees A-2 on Wrought Iron, and D-1 on Paint and Related Products. Prior to his affiliation with the Union Pacific in 1916, Dr. Barr was associated in chemical research work with leading chemical companies. In A.S.T.M. he was concerned with a variety of products, perhaps in particular steel forgings, and he headed Subcommittee VI on Steel Forgings for several years. During his term changes and improvements were made in the forgings specifications.

Lt. Col. William H. Bassett, Jr., for several years Commanding Officer, U. S. Department of the Army, Birmingham Ordnance District, Birmingham, Ala., and previously stationed in the Cincinnati and Springfield (Mass.) Ordnance Districts, has been assigned to the Far East Command. He expects to be out of the United States until at least 1952. While in the Birmingham District, Col. Bassett completed compilation of a brochure on research and development facilities in that area (covering the five states—Florida, Georgia, Alabama, Mississippi, and Louisiana). Prior to departure for his new asignment he was honored by the Third Army with the Award of Achievement for his last year's work, and was presented with an engraved silver tray by the Birmingham Post, American Ordnance Association, in appreciation of his work in Birmingham. A member of A.S.T.M. since 1920, and active through the years in diverse technical groups of the Society, Col. Bassett during his earlier affiliation was on the metallurgical staffs of the American Brass Co., Waterbury, Conn., and the Anaconda Wire and Cable Co., Hastings-on-Hudson, N. Y.

Ray T. Bayless, Assistant Secretary, American Society for Metals, and Vice-Chairman, A.S.T.M. Cleveland District Council, has been elected a Director of the National Rifle Association of America. Let this be a warning to all those who may have any slight differences of opinion with the genial Mr. Bayless. We had known that Ray got his share of pheasants out in the Dakotas every once in a while, and now can understand fully why!

C. R. Bragdon, Manager, Special Services Dept., Research Labs., Interchemical Corp., New York City, is the new Chairman of the Division of Paint, Varnish and Plastics Chemistry of the American Chemical Society.

Wallace R. Brode has been appointed Editor of the *Journal of the Optical Society of America*. Dr. Brode is Associate Director of the National Bureau of Standards, Washington, D. C.

George Granger Brown, Head of the Department of Chemical Engineering at the University of Michigan, has been appointed Director of Engineering for the Atomic Energy Commission. Dr. Brown, who will be on leave of absence for one year from his university post in order to carry on his new duties, is particularly well known for his work in the field of distillation. He has been on the chemical engineering staff at the University of Michigan for twenty-five years and has been head of the department since 1942.

Miles D. Catton, formerly Manager, Soil-Cement Bureau, Portland Cement Assn., Chicago, has been appointed Director of Development with headquarters at the Association's new Research and Development Laboratories, 5420 Harrison St., Skokie, Ill. His work will be directed toward the development of new products and processes, and to new and improved uses of cement and concrete. Joining the Association in 1926, Mr. Catton has served in various capacities, and throughout the years has carried on intensive studies of the feasibility of scientific control of mixtures of native soil and portland cement to produce a low-cost paving material. As a result of his studies, laboratory and field control tests and construction procedures were worked out for soil-cement construction.

H. V. Churchill, Chief of the Analytical Div., Research Labs., Aluminum Company of American, New Kensington, Pa., was recipient of the 1949 Award of the Pittsburgh Section of the American Chemical Society. Presentation was made at the December meeting of the Section which included a number of interesting talks on the medalist's career and his contributions to science.

John Clarkeson, formerly Chief, Design Section, Bureau of Public Roads, Albany, N. Y., is now Consulting Engineer, Massachusetts Dept. of Public Works, Reading, Mass.

Edgar O. Dixon, Chief Metallurgical and Mechanical Engineer, Ladish Co., Cudahy, Wis., has been named a member of the Education Committee of the American Society for Metals.

George C. Ernst (member since 1938), and E. H. Dunmire have formed a partnership under the name of Dunmire & Ernst, Consulting Engineers, Lincoln, Nebr., as successors to E. H. Dunmire of the same city. The partnership will specialize in structures, water works, sewage treatment, irrigation, electrical systems, and appraisals. Mr. Ernst retains his association with the University of Nebraska as Professor and Chairman of the Department of Civil Engineering.

F. Fahland has been appointed Research and Standards Engineer, Union Pacific Railroad Co., with headquarters at Omaha, Nebr. He succeeds William M. Barr, recently retired.

Francis B. Foley, formerly with The Midvale Co., Philadelphia, is now associated with the International Nickel Co., Research Laboratories, at Bayonne, N. J.

Lloyd A. Hatch, representative of the Minnesota Mining and Manufacturing Company's Sustaining Membership in the Society, and formerly Vice-President and General Manager of the Roofing Granule Division, has been appointed Vice-President in Charge of Research and Product Development by Richard P. Carlton, who was recently elected President.

H. Clay Howell, formerly Chief Chemist, Barber Oil Corp., New York City, is now Resident Manager, Brighton Terminal, Ltd., Port of Spain, B. W. I. Mr. Howell has been a member of Committees D-4 on Road and Paving Materials, and D-8 on

Bituminous Waterproofing and Roofing Materials for several years, serving as Secretary of the latter group since 1946. Because of the transfer he has found it necessary to relinquish this office, but is retaining membership on the two committees.

The Institute of Petroleum, London, England, has nominated C. A. P. Southwell as President for the Session 1950–1951. Mr. Southwell, who is Managing Director, Kuwait Oil Co., Ltd., and formerly Manager of Fields and Geological Branch, Anglo-Iranian Oil Co., Ltd., was elected to the Council of the Institute in 1936 and was made a Vice-President in 1948.

Howard H. Irvin has been appointed Chief Chemist at Marbon Corp., Gary, Ind. Mr. Irvin joined the corporation in 1943, and until the recent change was employed as Research Chemist.

W. James, formerly Superintendent, Standard-Vacuum Petroleum Mij., Sumatra, Indonesia, is now Research & Dev. Supervisor, Caltex Petroleum Maatschappij, N. V., Rotterdam, The Netherlands.

Roy H. Kienle, Assistant Research Director of American Cyanamid Co., and Director of Application Research at Calco Chemical Division, received the first Joseph J. Mattiello Lecture Award, presentation being made at a recent meeting of the Federation of Paint and Varnish Production Clubs in Atlantic City.

E. S. Kopecki, for several years on the staff of the metallurgical magazine *Iron Age,* New York City, and more recently Metallurgical Editor, is now with the Special Chemicals Department of the Pennsylvania Salt Manufacturing Co., Philadelphia, Pa.

Anthony H. Lamb, pioneer in the field of photoelectricity, recently was appointed Vice-President of the Weston Electrical Instrument Corp., Newark, N. J. Mr. Lamb will assume responsibility for operation of the Tagliabue Division of the company.

S. K. Love, Chief, Division of Quality of Water, U. S. Geological Survey, Washington, D. C., is the incoming Chairman of the Division of Water, Sewage, and Sanitation Chemistry of the American Chemical Society.

Herman Mark, Director of the Polymer Research Institute at the Polytechnic Institute of Brooklyn, has been invited by the Indian National Research Council to visit India in January and February, 1950, and to deliver lectures on the scientific and practical aspects of the physics and chemistry of high polymers in several institutions there.

Ralph R. Matthews retired December 31, 1949, as Executive Vice-President of Battenfeld Grease and Oil Corp., Kansas City, Mo. A graduate of the University of California, Mr. Matthews became affiliated with Battenfeld in 1928 after an association of several years with Roxana Petroleum Corp. (later Shell Oil) at various locations. An authority in his field, he has written articles for various technical and trade journals, and made numerous addresses before technical and trade groups. Active through the years in the work of many societies he was instrumental in organization of the Division of Petroleum Chemistry of the American Chemical Society, assisted in the organization of the Kansas City Section of the Society of Automotive Engineers, is a charter member of the National Lubricating Grease Institute and the American Society of Lubrication Engineers, and a member of the 25-year Club of the American Petroleum Institute and of its Lubrication Committee. A member of A.S.T.M. since 1928, he has been active in the work of Committee D-2 on Petroleum, being one of the group who sponsored fuller recognition of lubricating greases by the organization of its Technical Committee "G."

Robert F. Mehl, Director of the Metals Research Laboratory and Head of the Metallurgical Engineering Department of Carnegie Institute of Technology, Pittsburgh, Pa., has been appointed a member at large of the National Research Council of the National Academy of Sciences.

Joseph J. Mikita, Director of Petroleum Laboratory, E. I. du Pont de Nemours and Co., Inc., Deepwater Point, N. J., was recently promoted to the position of Assistant Technical Manager in the Petroleum Chemicals Division, Wilmington, Del.

Ananda Chandra Padhi has completed graduate studies at the Massachusetts Institute of Technology and is now located at Orissa, India, as Civil Engineer.

Stuart M. Phelps, Mellon Institute of Industrial Research, has been chosen as recipient of the 1950 Albert Victor Bleininger Award of the American Ceramic Society, the highest honor conferred in this country for "distinguished achievement in the field of ceramics." The award, which consists of a medal and scroll, will be presented to Mr. Phelps at a dinner in his honor at the Hotel Schenley, Pittsburgh, Pa., on March 10, 1950. Throughout his professional career Mr. Phelps has been associated with Mellon Institute, coming in 1917 as laboratory assistant, in 1918 receiving appointment to the Refractories Fellowship, and becoming Senior Fellow in 1926. His fellowship is maintained by the American Refractories Institute, for which he is now Director of Research and Tests. He has made many valuable contributions to the technology of refractories, and has become, in midcareer, one of the best known and most widely recognized authorities in his field. Mr. Phelps has long been an active member of A.S.T.M., rendering important service in Committee C-8 on Refractories. He served as Secretary of that committee 1936–1948.

R. E. Price, formerly Chief Chemist of Crosby Chemicals, Inc., DeRidder, La., has been elected Vice-President of this company.

Nicol H. Smith has been appointed Director of Research Operations on the Franklin Institute Laboratories for Research and Development, Philadelphia, Pa. Dr. Smith represents the Institute on A.S.T.M. Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys. Other recent Institute appointments include **Ralph H. McClarren** as Associate Laboratory Director, and **Harry H. Stout, Jr.,** as Assistant Director for Contract Administration. Messrs. McClarren and Stout are also serving on several of the Society's non-ferrous technical groups.

Grant T. Wernimont, Research Analytical Chemist, Eastman Kodak Co., Rochester, N. Y., assumed office January 1, 1950, as Chairman of the Division of Analytical Chemistry of the American Chemical Society. This A.C.S. Division was formerly known as the Division of Analytical and Micro Chemistry.

Norman H. Withey, formerly Engineer, Newport Industries, Inc., Madison, Wis., is now President, Norman Withey & Co., Inc., of the same city.

L. T. Work, Chemical Engineer and Consultant, Powdered Material Research Laboratories, Cambridge, Mass., was elected Chairman of the Division of Industrial and Engineering Chemistry of the American Chemical Society at its annual meeting at Atlantic City in September.

NECROLOGY

F. G. Boye, U. S. Testing Co., Hoboken, N. J. Representative of his company on Committee D-13 on Textile Materials since 1943.

B. M. Crum, Chief Chemist, The Stanley Works, New Britain, Conn. (December 17, 1949). Representative of company membership from 1920 to 1930, and personal member since 1931. Member of Committees A-5 on Corrosion of Iron and Steel, and D-1 on Paint and Related Products since 1925, and of Committee A-1 on Steel from 1922 to 1938.

H. C. Dickinson (Retired), formerly Chief, Heat and Power Div., National Bureau of Standards, Washington, D. C. (November 26, 1949). Member since 1911, and member of Committee D-2 on Petroleum and many of its subcommittees since 1922; also for many years member of Committees C-16 on Thermal Insulating Materials, D-5 on Coal and Coke, E-1 on Methods of Testing, and former Committee D-15 on Thermometers and Laboratory Glassware. Born in Bangor, Me., Dr. Dickinson was a graduate of Williams College and Clark University. He joined the Bureau of Standards in 1903 as an assistant physicist, and in 1921 became a division chief, retiring in 1945 after 42 years of service. He was a member of many societies and clubs. An organizer of the Society of Automotive Engineers in 1921, he became president in 1933, and later was made an honorary life member. He also was instrumental

in establishing the Cooperative Fuel Research Council. As an authority on highway safety, he was for many years chairman of the Highway Research Board of the National Research Council.

THOMAS A. HICKS (Retired), formerly General Chemist, Universal Atlas Cement Co., New York, N. Y.; residence, Sandusky, Ohio (December 26, 1949). Member since 1914, and member of Committee C-1 on Cement since 1914, being elected to Honorary Membership in that group in 1944. Formerly a member for many years of Committees C-11 on Gypsum and D-13 on Textile Materials. Born in Toledo, Ohio, in 1873, Mr. Hicks was a graduate of the Case School of Applied Science, Cleveland, Ohio, and began his business career in 1897 when he was appointed Chief Chemist of the Art Portland Cement Co. near Sandusky. His second association in the same capacity was with the Whitehall Portland Cement Co. at Cementon, Pa. In 1904 he joined the Atlas Portland Cement Co. as Chief Chemist at its Northampton, Pa., plant; became General Chemist for the Atlas Co. in 1916, and for the Universal Atlas Co. in 1930, retiring in 1943. During his thirty-nine years of service with the Atlas and Universal Atlas companies, Mr. Hicks was intimately identified with important work in the cement industry. Highly esteemed by his friends and associates, Mr. Hicks will long be remembered for his cheerful friendliness, as well as his professional attainments and valued contributions to the progress and development of the cement industry.

HARRY D. JUMPER, Chief Engineer, Consolidated Rock Products Co., Los Angeles, Calif. (December, 1949). Representative of company membership since 1945, personal member 1942–1945, and representative of his company since 1945 on Committee C-9 on Concrete and Concrete Aggregates. Mr. Jumper filled an important place in the technical staff of Consolidated Rock Products, and had made valued contributions to the work of Committee C-9, in which group his counsel will be greatly missed. In addition to his business and professional activities, Mr. Jumper was Mayor of the City of Azusa, Calif., and devoted much of his time to this civic project.

H. E. KILGUS, President, Brockway Clay Co., Brockway, Pa. (November 12, 1949). Member since 1917, and member for many years of Committee C-4 on Clay Pipe and its subgroup on Nomenclature.

ANSON MARSTON, Dean Emeritus of Engineering, Iowa State College, Ames, Iowa (October 21, 1949). Member since 1905; member of Committee C-4 on Clay Pipe for many years, and Chairman of that group from 1937 to 1944; member of Committee C-13 on Concrete Pipe since 1932, and formerly member of Committees C-6 on Drain Tile, and E-5 on Fire Tests of Materials and Construction; also member of the Executive Committee of the Society for two terms—1914–1916 and 1924–1926. A native of Illinois and graduate of Cornell University (1889) Dean Marston joined the Iowa State faculty in 1892, after three years in railroad work, becoming dean in 1904, senior dean in 1932, and dean emeritus in 1937. He served engineering on both a statewide and nationwide basis. He was the first dean of engineering at Iowa State, the first director of the Iowa Engineering Experiment Station, and a member of the state's original highway commission. He was a member of the Engineering Board of Review, Sanitary District of Chicago, the Florida Everglades Commission, the Interoceanic Canal Board, the Mississippi River Engineering Board of Review, and the National Research Council. He served as a Lt. Col. of Engineers in World War I, and was consultant on several engineering projects in the Middle West. Active in the work of many societies, he was the recipient of many honors and awards. Dean Marston's death at the age of 85 was the result of an automobile accident. An active civil engineer to the end, he was completing information on many years of culvert-loading experiments. He had published about 200 professional papers and technical reports, and was the author of "Sewers and Drains" and "Engineering Valuation," the latter in collaboration with his successor as dean of engineering, the late T. R. Agg.

FREDERICK MILLS, Chief Mechanical Engineer, Western Australian Government Railways (June 22, 1949). Representative of membership of Western Australian Railways since 1942.

F. HUGH MOREHEAD, formerly Vice-President and Chief Engineer, Walworth Company, New York, N. Y.; residence, Sierra Madre, Calif. (November 27, 1949). A member since 1926, Mr. Morehead's committee memberships included A-1 on Steel, A-3 on Cast Iron, B-5 on Copper and Copper Alloys, and A-7 on Malleable-Iron Castings. In each group he had been a member of several subcommittees. His service on Committees A-1 and A-3 dated from 1928, and he served for over fifteen years on the other groups. Mr. Morehead was well known in the valve and fittings industry, having served as chairman of important standardization committees of the A.S.A., A.S.M.E., and M.S.S. He had retired from the Walworth Company in December, 1948, and had made his home in California since 1946.

CHARLES SNYDER REEVE, Consulting Chemist, of 255 Glenwood Ave., Leonia, N. J. (January 6, 1950, in Clearwater, Fla.). Born in Philadelphia in 1875, Mr. Reeve was graduated from the University of Pennsylvania in 1897. His first position was with the General Electric Co. at Schenectady as Assistant Chemist; later he was with the Industrial Water Co.; and in 1904 with the Bureau of Surveys, Philadelphia, he equipped and operated that city's first laboratory for testing asphalt paving materials. In 1906 he was appointed Assistant Inspector of Asphalt and Cement of the District of Columbia, and in 1909 was appointed to the Office of Public Roads, U. S. Department of Agriculture, where he was engaged in testing and research on bituminous road materials. For twenty-seven years he was on the technical staff of The Barrett Co., New York, N. Y., serving successively as Research Chemist, Chief Chemist, and Manager of Research and Development, retiring from active service with the company in 1945, though continuing in a consulting capacity. A member of A.S.T.M. since 1904, Mr. Reeve's principal activities in the Society were in the field of bituminous materials. He was a founder member of Committee D-8 on Bituminous Waterproofing and Roofing Materials (1905), also a Vice-Chairman of Committee D-4 on Road and Paving Materials, and was active in the reorganization of the Committee on Thermometers, serving as Secretary for many years. He also served for many years on other technical committees, in particular those concerned with paint, wood, rubber, methods of testing, methods of testing building constructions, and nomenclature and definitions. On the administrative side, he served on the Committee on Papers and Publications 1929–1933, and on the Executive Committee 1936–1938. In recognition of his intensive activity through the years in various phases of A.S.T.M. work and his outstanding leadership in his field, Mr. Reeve was awarded Honorary Membership in the Society at the 1946 Annual Meeting in Buffalo. Mr. Reeve also was active for a number of years in the work of the preservative committees of the American Wood Preservers Association, and in addition held membership in other technical and scientific societies. He was the holder of numerous patents and had written many technical papers and reports, including several in A.S.T.M. publications.

JOSEPH L. SCHWARTZ, President, Tru-Test Laboratories, Inc., Philadelphia, Pa. (April, 1949). Member since 1945.

E. L. WALTERS, Shell Development Co., Emeryville, Calif. Represented his company on Technical Committee J, Section on Stability, of Committee D-2 on Petroleum Products and Lubricants.

Notes on Laboratory Supplies

Catalogs and Literature; Notes on New or Improved Apparatus

This information is based on literature and statements from apparatus manufacturers and laboratory supply houses.

Catalogs and Literature

Eastman Kodak Co., Rochester 4, N. Y. An eight-page booklet providing data on special films and plates for laboratory use has recently been issued by Eastman. The book includes a description of emulsions available for spectrographic work, photomicrography, and nuclear track studies. Complete information is given regarding the sensitivity of these emulsions. The booklet is available from the Industrial Photographic Division of Eastman.

E. H. Sargent & Co., 4647 W. Foster Ave., Chicago 30, Ill. "Scientific Apparatus and Methods Including Latest Catalog Revisions"—Fall, 1949—includes chapters in Section One—Scientific Methods—on "Sargent's Chicago Plant Occupies Large, Modern New Home" and "The Polarography of Carbonyl Compounds." Section Two—Scientific Apparatus—includes chapters on New Items, Reinstated Items, Discontinued Items, and Changes in Specifications. Illustrated.

Scientific Glass Apparatus Co., Inc., 49 Ackerman St., Bloomfield, N. J. "What's New for the Laboratory"—latest issue (Number Nine)—a twelve-page booklet describing new equipment and instruments. A few of the models illustrated are: Utility Ovens, Insulated Laboratory Sterilizer, Weight Set, Hevi-Duty Muffle Furnaces, Automatic Pipet, Manostat, etc.

The Radiac Co., 489 Fifth Ave., New York 17, N. Y. A new folder illustrates and describes various models of Geiger-Müeller Counters and metal detecting instruments, such as the Detectron, Model DG-10, Laboratory-Type Geiger Counter, and Model 2610A, a highly calibrated portable Survey Meter with external probe. Nine pages.

Arthur L. LaPine & Co., 121 W. Hubbard St., Chicago, 10, Ill. Volume 1, Issue 1, of Lanco Apparatus News, which lists many new items of interest in the laboratory, including wash bottles, Lanco uni-drawn stainless steel laboratory sinks, torsion balances, tapered wire test tube baskets, lime glass stopcocks, Lanco safety cylinder support, and others. Four pages, illustrated.

Consolidated Engineering Corp., 620 N. Lake Ave., Pasadena 4, Calif. A four-page folder covering "Isotope-Ratio Measurement" illustrates the Model 21-201 Consolidated-Nier Isotope-Ratio Mass Spectrometer which is in use in medical, biological, and chemical research laboratories. The features of this spectrometer include dual collection, operating controls located on a sloping panel at a convenient height for a seated operator, switching controls which permit the taking of a variety of measurements, sample introduction system in reach of a seated operator and designed for flexibility of use, and others.

The Baldwin Locomotive Works, Philadelphia 42, Pa. A new twelve-page Bulletin, No. 279-A, covering SR-4 Strain Gages for Stress Analysis, tells how to select and use SR-4 bonded resistance wire strain gages in stress analysis. It explains the fundamentals of both simple and practical strain gage circuits and eight different types of instruments. Instruments range from a Wheatstone bridge control box to oscillographic equipment and automatic self-balancing indicators and recorders, and include switching units for multiple gage installations.

Also, Bulletin No. 279-B "How to Apply SR-4 Strain Gages" gives detailed procedures for attaching SR-4 resistance wire strain gages to surfaces and is illustrated by 18 cartoons animating the strain gages to show their reactions to correct and incorrect methods. Instructions are given for surface preparation, cementing, clamping, heat drying, moisture-proofing, and testing of gages after bonding in order to assure proper application. Eight pages.

Another Baldwin Bulletin describes and gives complete specifications for SR-4 pressure cells of eight capacities from 200 to 50,000 psi. A wiring diagram and cross-sectional sketches of the cell and seal-off unit are included. Bulletin 306, superseding Bulletin 270.

Also, Bulletin 307, describes Type "C" SR-4 load cells in which SR-4 resistance wire strain gages bonded to a column are the load-sensitive elements. Cell capacities range from 2000 to 200,000 lb. in seven sizes. Specifications include physical dimensions, accuracy, electrical data, overload characteristics, fatigue life, effects of sustained and impact loads, dynamic load measurement, and temperature limits.

Instrument Notes

Fatigue Testing Machine—The Baldwin Locomotive Works, Philadelphia 42, Pa. This new machine of 10,000-lb. total capacity is known as the SF-10-U. It applies alternating vertical forces at a frequency of 1800 cycles per minute and maximum amplitude of ½ in. Load accuracy is within 2 per cent of load or 0.4 per cent of capacity, whichever may be the greater. The machine operates by the same constant-force principle as other SF type fatigue machines. Dynamic loads are applied by the centrifugal force of a mass rotating at constant speed in an oscillating frame. The force is accurately controlled by varying the distance between the mass and its center of rotation. Inertia forces are compensated by carefully designed springs and calibrated weights.

Laboratory Hot Plate—Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa. This hot plate provides stepless heat control, incorporates a number of design features, and is now available in 12 by 12-in. and 12 by 24-in. sizes. The "Temco" hot plate, after attaining a surface temperature of 500 F. consumes current only 50 per cent of the time, and its heating elements are embedded for safety. Temperatures can be maintained within close limits over the range 140 to 850 F. and the elements are of flat type which prevent "cold" spots. The lower portion, housing controls, is separated from cast aluminum top plate by "Trancell" insulation, and louvers are provided to help carry any heat away from table top. The new heater is furnished either for 115 or 230-volt operation.

U. S. Weather Bureau Illumination Recorder—The Henry A. Gardner Laboratory, Inc., Bethesda 14, Md. This instrument gives a continuous record of illumination on an approximate logathrithmic scale from 0–10,000 foot-candles. It consists of two parts: a photocell unit outdoors with unobstructed exposure to the sky, and an indoor recorder measuring the photocell's output. Data from the apparatus may be used by power companies to determine the relation between power load and outdoor illumination.

Constant Temperature Baths—The Henry A. Gardner Laboratory, Inc. Item V-0 is an aquarium type, glass construction, full vision bath which is usable with Gardner Bubble Viscometer Tubes, the Gardner Mobilometer, the Interchemical Inclined Tube Viscometer, etc. It is useful for bringing a wide variety of materials to temperature equilibrium. Item V-4 is a dual constant temperature bath constructed of stainless steel, designed for use with the No. Ford Type Viscosity Cup manufactured by Gardner, as well as for general constant temperature work. Item V-5 is of the same type construction and controls as Item V-4, with exception that this bath is not designed to retain viscosity cups but is designed for general utility use only.

Arco Microknife—The Henry A. Gardner Laboratory, Inc. This is a precision-built instrument for testing scratch hardness and adhesion of paints and other coatings. The load, measured in grams, is applied to the point which moves across the surface at a constant speed and cuts repeatedly in a fixed position until the subsurface is revealed. The load on the beam and the number of strokes required to wear through the film are the measure of scratch hardness. Used in connection with a movable platform which can be adjusted laterally by a precise screw thread and notched wheel, the Microknife becomes an adhesion measuring machine. It is possible to measure the relative adhesion of a coating to base metals and subcoatings, as well as to record changes in adhesion caused by aging of the paint.

Manometer—The Emil Greiner Co., 20–26 N. Moore St., New York 13, N. Y. This is for measurement of pressure and vacuum. The latest model is improved in six different ways, namely, added protective bracket for the stopcock; rod on back of stand for mounting on a frame; new metal rod to carry the vernier; vernier now mounted on a block containing a U cut-out to eliminate parallax; hollow ground high vacuum stopcock is used on the glass assembly; size of base increased to give better stability.

Gilmont Ultra-Microburet—The Emil Greiner Co. This latest model has been improved four ways, namely: added crank handle for easier manipulation; swivel connection for easy disengagement of screw; new gage mounting to assure alignment; new position of the support rod to provide more space for test tubes and accessories. Rapid titration can be achieved with this new model.

Todd Universal Absorption Trap—The Emil Greiner Co. This Trap is used for removing acid and alkaline vapors, moisture, etc., by means of a special absorbent of large capacity. This Todd Universal Absorbent is a blend of chemical absorbents which may be regenerated several times. The uniform physical state of the absorbent causes no significant pressure drop through this trap.

Laboratory Equipment Corp., St. Joseph, Mich., announces the availability of ceramic tubes, crucibles, and various other shapes in Magnesia, Beryllia, Zirconia, Thoria, and Recrystallized Alumina. These materials are used for various special applications up to 3000 C. (5400 F.).

Thomas Autometer—Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa. Industrial plants which discharge gases containing sulfur dioxide can be warned against atmospheric pollution by means of this automatic analyzing equipment. This continuously records actual concentration of sulfur dioxide in parts per million; and, also records average concentration integrated over a half-hour period, automatically checks its "zero reading" every 30 minutes, and marks off each cubic foot of air sampled. The Autometer makes use of electrolytic conductivity as a means of measurement. A continuous sample of air is passed through a solution which absorbs SO_2, causing a change in the electrolytic conductivity of the solution.

Micro and Semi-Micro Combustion Apparatus—E. H. Sargent & Co., 4647 W. Foster Ave., Chicago 30, Ill. This new combustion apparatus, developed in consultation with both commercial and academic micro laboratories, is designed for use where a large volume of elementary analysis for carbon, hydrogen, and nitrogen in rare organic compounds is performed. The apparatus heats from room temperature to 700 C. in approximately seven minutes and cools from 750 C. to room temperature in approximately ten minutes. It radiates but little heat; is compact and features a two-speed automatic drive and programming controls, providing four different three-phase programs, or two-phase or single-phase programs as selected.

Micro and Semi-Micro Radiant Type Sargent Combustion Furnace—E. H. Sargent & Co. This furnace permits the tube filling to cool with approximately the same speed while the furnace remains in place. The furnace is mounted on a case with panel which contains all controlling equipment, including temperature indicating meter, switch, pilot light, and variable transformer control for selection of burning temperature. Practical operating temperature range extends to 850 C. and the helical element and shell apertures will accommodate either the standard micro tube or larger tubes with outside diameter not exceeding 14 mm.

Electric Hot Plate—Thermo Electric Manufacturing Co., Dubuque, Iowa. A thermostat provides variable control from 100 to 700 F. (38 to 370 C.). Temperature variation is held within 5 at 100 F. and within 2 from 200 F. to maximum. The cast aluminum surface plate heats evenly and quickly. Its square shape permits greater usable surface area. It is insulated on the bottom side and is mounted within the metal body with only four small points of contact to minimize heat conduction to the body.

News of Instrument Companies

H-B Instrument Co., Philadelphia, Pa., has recently purchased the thermometer business of the American Thermometer Co. of St. Louis, Mo.

The Frederick S. Bacon Laboratories, 192 Pleasant St., Watertown, Mass., celebrated its Tenth Anniversary as consultants in chemical research and development with an open house on December 1, 1949. This affair was attended by the laboratories' many clients and distinguished chemists from New England's universities and industries. These laboratories are equipped for research by the 16 staff members on adhesives, plastics, leather, rubbers, textiles, organic syntheses, dyestuffs, bacteriology, metal plating, ceramics, paints, and varnishes.

Carl G. Amend, a director and former president of Eimer & Amend, New York, N. Y., died on November 28 in Brewster, N. Y., after a long illness. In 1910 he joined the firm of Eimer & Amend, a laboratory supply house in New York, which was founded by his grandfather. In 1934 he succeeded his father as president of the company, retiring in 1940. He had been active as a director since the sale of Eimer & Amend to the Fisher Scientific Co. of Pittsburgh.

The Macbeth Corporation has announced that effective January 2, 1950, it will be occupying its new plant in Newburgh, N. Y. From that date on all manufacturing activities of the Macbeth Corporation, together with its executive and general offices, will be located at Newburgh, which is situated on the west bank of the Hudson River, about sixty miles north of New York City. The greatly increased area available for use in this fine, modern plant will permit an expansion of Macbeth manufacturing and research facilities and allow improved service to its many customers.

The Board of Directors of Bausch & Lomb Optical Co., Rochester, N. Y., recently announced the election of M. Herbert Eisenhart as Chairman of the Board. He has been President of Bausch & Lomb since 1935. Joseph F. Taylor, Vice-President and Treasurer, was elected to succeed Mr. Eisenhart as President. William W. McQuilkin, who joined the company as Counsel in 1938, and has been Assistant Treasurer since 1947, succeeds Mr. Taylor as Treasurer.

Sperry Products, Inc., Danbury, Conn., has announced the opening of a commercial ultrasonic testing service for metals-producing, -processing, and -fabricating plants, and for maintenance inspection. This service provides day-to-day testing in the field or at the Sperry plant. Sperry service centers are so located as to provide prompt testing service in most industrial localities.

The Atomlab Co., 489 Fifth Ave., New York 12, N. Y., announces that it has completed its organization. Atomlab services science, industry, and government in the field of nuclear physics and instrumentation. The company is under the supervision of M. M. Reiss, who was formerly Chief of Scientific Liaison for the Atomic Energy Commission at the Brookhaven National Laboratory, and Committee Chairman of the National Research Council. It operates a repair shop and Radiochemical Laboratory in Center Moriches, Long Island, N. Y., and sales offices in New York City.

Steels for Elevated Temperature Service

Recently issued by the United States Steel Corp. is an excellent publication entitled "Steels for Elevated Temperature Service." Copies of this publication will be furnished to those who have a genuine interest in the subject and who write on their company stationery addressing United States Steel Corporation Subsidiaries, 2130 Carnegie Building, Pittsburgh 30, Pa.

Following a discussion of the nature of creep and information on the measurement of flow under stress at elevated temperatures there is a section covering the factors affecting high-temperature properties. Then follows a condensed chapter covering the behavior of steels involving internal stability, external or surface stability, and other properties. The major portion of the wire-bound booklet provides tabular and graphical data on the properties of typical steels for use at elevated temperatures. There is a discussion of the U. S. Steel and Subsidiary Companies' facilities for research and testing, and finally a short but useful bibliography.

In connection with this publication it is of interest that A.S.T.M. is in the course of publishing an extensive report with a great deal of information and data on wrought steels for use at elevated temperatures. Further announcement concerning the availability of the book and its price will be made.

Structural Clay Products Industry Research Foundation

An announcement of an extensive research program of interest to A.S.T.M. members was included in a news release from the Structural Clay Products Institute. The release referred to the first general meeting of the newly formed Structural Clay Products Industry Research Foundation. The Foundation is currently launching a million-and-a-quarter dollar research plan supported by brick and tile manufacturers in both United States and Canada, aimed mainly at end-use of structural clay products. E. F. Plumb, Streator, Ill., is the Chairman of the Foundation.

ASTM Papers—Their Preparation, Acceptance, and Publication*

This Article is printed on the authority of the Administrative Committee on Papers and Publications and was prepared for the Committee by Messrs. G. R. Gohn, R. C. Adams, and K. B. Woods.

To keep the members informed of the technical and scientific progress made in the ever-expanding fields of interest of A.S.T.M., technical papers are regularly published in the *Proceedings*, in the Special Technical Series, and in the BULLETIN. The papers published are of various types and character. They may be of the research, review, descriptive, or discussion types. Some may be contributions describing original research, while others may be well-coordinated reviews. Some are of theoretical value, others of practical value. Some are of permanent interest, others of temporary interest. But regardless of the field of interest covered, or the type and character of the paper, the most desirable characteristic is technical excellence.

A good technical paper should be direct, understandable, and readable. While technical excellence in a paper is not an easily achieved goal, the quality of such a paper is greatly improved by proper planning. This planning starts before the preparation of the paper and, wherever possible, should go back to the inception of the work being reported. A clear conception of the reasons for doing the work and careful planning of the work to develop the information which will give the desired answer make it possible to present a technically correct, concise paper with clear-cut conclusions.

In these days of increasing publication costs and restricted budgets the quality of a technical paper is of paramount importance in considering its acceptance. To assist the members in improving the quality of papers presented at A.S.T.M. sessions or published by the Society, a manual covering the preparation and presentation of technical papers is being prepared.[1] Read it, and use it to improve the quality of your papers.

Questions have arisen from time to time on A.S.T.M. publication practices. To familiarize the members of the Society with those practices and the system employed in the acceptance and publication of A.S.T.M. papers, specific questions are answered in subsequent paragraphs.

Who Has Charge of the Society Publications?

The Board of Directors ultimately controls publications and all activities of the Society. However, the Board has delegated authority on publications to the Administrative Committee on Papers and Publications. This Committee's decisions affecting the acceptance, rejection, editing, and publication of papers, committee reports and discussions usually are final, but in extraordinary cases recommendations or suggestions are made to the Board for final adjudication. The Committee is aided in its work by the Executive Secretary of the Society, who serves as its chairman, and by the Headquarters Staff. The latter supervise the details of editing, printing, and distribution.

Who May Submit a Manuscript?

There is no restriction on the authorship of Society papers. A large number are submitted by members of the Society or by representatives of company members because of their interest in the various activities of the Society. The technical content and not the authorship determines the acceptability of a paper.

How Are Manuscripts Obtained?

Most manuscripts are submitted directly to the Society by the authors. These papers are not solicited by any officer of the Society nor is any financial recompense given. Sometimes papers originate as a result of committee-sponsored activities. Occasionally papers are written at the request of committee officers because of a general feeling that some particular phase of the committee's work warrants presentation and discussion in a technical paper. In general, however, the majority of papers are submitted voluntarily by members. No person in the Society, either officially or unofficially, is authorized to pledge acceptance of a paper. *Acceptance is the prerogative of the Papers Committee alone.* The regulations dealing with the submission of papers, committee reports, and discussions are very definite in stating that full authority with respect to the acceptance, rejection, and editing of papers and the editing of reports including standards and discussions resides in the Administrative Committee on Papers and Publications.

In What Form Are Manuscripts Required?

In general, three complete copies of manuscripts, including all figures and tables, are required. One of these should be an original. The original is used later for editing if the manuscript is accepted for publication. The text must be typewritten, double spaced. Blueprints of the text or tables are not acceptable. Drawings and diagrams should be specially prepared since working drawings are seldom satisfactory. The Society has prepared information dealing with the type of drawings, photographs, and slides which are acceptable and authors are expected to follow these recommendations. These provisions are not arbitrary but have the definite purpose of expediting consideration by the Committee and for use by the editors. A number of additional details with respect to preparation of manuscripts are given in a separate pamphlet intended as a guide to authors. However, it should be borne in mind that before a paper is further studied by the Committee, the author is requested to assure the Committee that his manuscript is, in a large measure, original with him in that it has not been published or distributed under other auspices. Technical information readily found elsewhere is, in general, not acceptable, and, conversely, the Society reserves the right to authorize or refuse republication of an accepted manuscript in other publications.

What Is the Acceptable Size of a Paper?

Technical papers generally range in size from 6 to 30 pages. Papers in excess of 30 pages are seldom accepted because, in fairness to the various groups of members, it is desirable to have sufficient papers to cover all fields of interest rather than a few lengthy papers. However, one long paper of excellent quality is deemed preferable to several shorter but mediocre papers. Wherever condensation can be effected without loss of reader interest and without detriment to the presentation of the

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* Adapted from article on "Determining Acceptability of Paper for 'Proceedings,'" *Civil Engineering*, September, 1934, p. 497.

[1] This manual is being issued as a separate pamphlet and copies will be made available on request.

author's work, such condensation is suggested. Frequently this can be accomplished by the use of appropriate charts and curves instead of lengthy tables and by avoiding duplication between tables and graphs. A curve or a table may also be used effectively to save several pages of discussion.

Who Reviews Papers?

In its technical study of the various papers, the Administrative Committee on Papers and Publications depends largely upon opinions secured from selected reviewers. In some cases a paper known to fall within the field of a standing committee is referred to that committee for study. In many cases the standing committees have review groups set up for this purpose. The Papers Committee itself is composed of representative members who are familiar with the various activities of the Society, and at least one member of the Committee serves as a reviewer of each manuscript submitted. In most cases the reviewers are long-time members of the Society who are quite familiar with their field and are thoroughly competent to pass upon the technical matters discussed by the authors in their manuscripts. The character of technical ability represented by the reviewers constitutes a guarantee of the best opinion available.

How Are Reviewers Selected?

In addition to a member of the Papers Committee, papers are usually reviewed by at least two more persons particularly qualified by technical training and by experience to judge the subject matter. These reviewers, because of wide experience in their field, have ability to judge relative values and the application of principles, and are in sympathy with the high ideals of the Society in publishing only the best material submitted. They are men of high ethical standards who will treat the questions raised as confidential and will not give biased recommendation to the Papers Committee. Associates of the authors are not requested to review their papers. In general, personal relationships, so far as they may be known, are taken into consideration so that the reviews may be free from bias for or against the author and his paper. However, papers are distributed as widely as possible for review so as not to impose upon the reviewers' generosity.

How Are Independence of Review and Anonymity Secured?

Fairness to the author and the reviewer has led the Committee to conduct all of its business on the basis that the reviewers shall remain anonymous. Experience has shown that it is virtually impossible to maintain similar anonymity of the authors. A competent reviewer frequently can discern authorship from the subject or style and text of a manuscript. Reviewers are therefore advised of the authorship of any papers submitted to them for consideration. The confidential opinions of the reviewers may be used as the basis for suggested revision in the paper, but in no case is the author informed as to the source of these views. The purpose of these precautions is to make it as easy as possible for the expert to be perfectly frank and fair in his evaluation of a manuscript. There has never been any cause for complaint, and the Committee has never abused this confidence.

What Determines Acceptability?

The selection of suitable papers comprises one of the major duties of the Administrative Committee on Papers and Publications. Such papers are considered at two regular meetings of the Committee, one held in the fall, the other shortly after the beginning of the new year, so that ample time is given for consideration of papers prior to the Annual Meeting. Papers also may be submitted to reviewers for comment during the intervening months so that the Committee will have before it concrete recommendations with respect to various manuscripts when it convenes. More frequent meetings of the Committee are impractical because of the resulting inconvenience to the members and the expense to the Society. It is always possible in an emergency to canvass the Committee members by letter and thus to reach a decision in advance of a regular meeting.

Acceptance of papers is made in the order of their excellence. The number of accepted papers is limited by the amount of money allotted by the Board of Directors for the various publications. This means that not all of the manuscripts submitted can be published. Accordingly, preference is given to those showing the greatest excellence and to those which have the widest appeal to the members of the Society. In carrying out this policy every effort is made to develop a well-rounded program which will appeal to the diversified interests of the members.

In general, the Society cannot afford to republish data readily available elsewhere, although in the case of data of particular value to our technical committees extensive abstracts and reference to the original source of such data may be given in the BULLETIN. Likewise, it is frequently necessary to limit or reject the review type of paper in favor of technical papers representing original contributions of more permanent interest to the Society. The Committee's decisions, like any other human decisions, are not infallible. However, it has been the general experience of the Committee that the procedure which it has adopted actually accomplishes the aims of the Society.

Where Are Accepted Papers Published?

A paper accepted for publication may appear in the *Proceedings*, in the BULLETIN or in one of the Special Technical Publications. *Proceedings* papers are those having permanent reference value and which do not require immediate publication to further the activities of the Society. They may appear in the *Proceedings* appended to one of the committee reports, as papers presented at the technical sessions of the Society or as newly published material not previously presented before the Society. BULLETIN papers may be of a similar character to *Proceedings* papers. Many of them are of a general interest nature, but, in general, they have somewhat less permanent reference value, are progress reports essential to the advancement of the work of a technical committee, or are so timely that the delay in publication necessary to put them in the *Proceedings* is undesirable and might work to the disadvantage of the members of the Society. BULLETIN papers are frequently somewhat less formal than *Proceedings* papers, although in recent years all technical matter has been separated from the news material and libraries are currently cataloging such articles for reference purposes. Frequently a group of papers, such as those presented at a symposium or at a session devoted to the discussion of a single subject, have a particular appeal to a segment of the Society membership. Such papers may be grouped and published in one of the Special Technical Publications. There is little distinction between papers appearing in this series and *Proceedings* papers. The decision with respect to such publication is made by the Papers Committee in consultation with a group sponsoring the symposium or special session.

May Paper Accepted by the Society Be Reprinted Eleswhere?

Papers accepted by the Society become the property of the Society and can be reprinted in whole or part in other publications only upon specific written permission of the Society. However, citations or quotations may be made without such written permission provided proper credit is given to the Society.

What Disposition Is Made of Rejected Papers?

Rejected papers are returned to the author. In those cases where the reviewers' comments indicate the revisions will make the paper acceptable to the Society, it is suggested that the author revise his manuscript. He may do this and then resubmit the paper, or he may withdraw his offer. Manuscripts unacceptable for publication by the Society become the property of the author and he is at liberty to do whatever he wishes with such manuscripts. Suggestions for publication elsewhere are made whenever it is felt that another journal would be a more appropriate medium.

How Long Is a Paper in the Hands of the Committee?

At least six to eight weeks are required to process a paper and determine its acceptability. Three or four months represents a more normal period. In general, papers accepted for *Proceedings* publication or Special Technical Publications are presented at the Annual Meeting. The *Proceedings* are published the following December and the Special Technical Publications follow the Annual Meeting as rapidly as they individually can be compiled, edited, and printed. In many cases, preprints of papers are available in advance of the Annual Meeting. Abstracts of practically all *Proceedings* papers appear in the BULLETIN from time to time so that the members are kept informed of the activities of the Society. It should be borne in mind that the Papers Committee is far more concerned with excellence of material and its presentation rather than speed of publication.

Are Discussions Treated Like Papers?

Such exhaustive scrutiny of discussions as that applied to the technical papers is neither necessary nor desirable. The Committee, however, has set up definite principles for the guidance of the editors. It should be borne in mind that a discussion should be pertinent to the paper and not a forum for the presentation of the discusser's viewpoint except as it deals with the content of the author's work.

Conclusion:

The detailed consideration of A.S.T.M. papers, which has been discussed above, is intended to give the members of the Society the optimum return for their publication dollars. The first decision, as to whether the subject of a paper is within the Society's field and of interest to a reasonable number of its members, usually can be made promptly. This permits the author of a declined paper to seek another publication channel without delay. Review, revision, condensation, presentation, and publication are more time consuming. All are necessary, however, if the many factors, involved in technical publication are to be balanced. The continued cooperation between authors and the Society staff and Committee is expected to maintain our publications as the most significant source of information on the testing of materials.

Delegates attending the FAO Convention on Mechanical Wood Technology at the Palace of Nations, Geneva, Switzerland, August 29 to September 3, 1949. Front row, reading from left to right, George W. Wright, Commonwealth Scientific & Industrial Research Organization, Australia; Jean Collardet, Wood Industries Technical Center, France; L. J. Markwardt, U. S. Forest Products Laboratory, U.S.A.; Jean Campredon, National Forests Institute, France; Raymond Lazard, Ministry of Industrial Production, France; D. Roy Cameron, Palace of Nations, Geneva, Switzerland; Feliks Siimes, State Technical Research Institute of Finland. Second row, (unidentified); Otto Brauns, Swedish Work Research Institute; Guglielmo Giordano, Forests University of Florence, Italy; Erik Stephansen, Norwegian Pulp and Paper Research Institute; Khid Suvarnasuddhi, Forest Department of Bangkok, Thailand; John H. Jenkins, Forest Products Laboratories of Canada; (unidentified); Ing. Ernest Melan, Technical University, Vienna. Third row, Nicolas de Felsovanyi, F. A.O., Washington, D.C., U.S.A.: (unidentified); Edgar Moerath, Austrian Society for Wood-Research; John Lathan, Department of Scientific and Industrial Research, England; Ernest Travnik, Research Institute of Bratislava, Czechoslovakia; Jacques L. Bienfait, Forest Products Research Institute, Pays-Bas; Matthaus Schlager, Federal Timber Office of Austria. Fourth row, (unidentified); Jos. A. G. Fourage, Forests Laboratory and Agricultural Institute, Belgium; (unidentified); (unidentified); Jack Leigh, Ministry of Supply, England; Richard Bateson, Ministry of Works, England; Frithjof Plahte, Norwegian Institute of Wood Working and Wood Technology; (unidentified); Hellmut Kühne, Federal Material Testing Laboratory, Switzerland. See also p. 45 for another picture of delegates.

FAO Committee on Mechanical Wood Technology Holds Conference at Geneva, Switzerland

By L. J. Markwardt[1]

EDITORS NOTE:—In view of the current interest in international discussion on standardization, the accompanying report by Mr. Markwardt is reproduced here as an outstanding example of organization and accomplishment.

INTRODUCTION

SOME 34 delegates and observers from 20 countries attended the Food and Agriculture Organization (FAO) Conference on Mechanical Wood Technology held at Geneva, Switzerland, August 29 to September 3, 1949. This represents a substantial increase in attendance and representation over the 1948 meeting of this committee, and indicates a broadening interest in its work.

The committee on Mechanical Wood Technology is one of several established under the Forest Products Branch, Division of Forests and Forest Products of the FAO. As the name implies, it is concerned with the various problems of a mechanical and engineering nature relating to the utilization of wood and wood-base materials. The organization of this forest products work follows logically from recognition of the now well-accepted principle that forest products utilization practices have a direct bearing on forestry and on silviculture; and that forest products research aimed at making our forest resources go farther and serve mankind better is an essential factor in forest economy. Since forest products in many forms are items of world commerce, and since three species extend beyond international boundaries, there are naturally a large number of problems on which international exchange of information and agreement on practices are highly desirable.

More and more the economical use of timber and the reduction of wood waste are dependent on accurate data about its structure and chemical and physical properties, on new methods of chemical conversion, and on improved marketing practices, such as the development of efficient structural grades that insure the most effective use of its strength. For the national solution of such problems, many countries, including the United States, have established forest products research laboratories or carry on such research in conjunction with other research agencies.

[1] Delegate of the U. S. A.; Assistant Director, U. S. Forest Products Laboratory, Madison, Wis.

Since the results of any tests, whether chemical or physical, are dependent upon and intimately related to the test methods used, it is apparent that fully comparable results by different investigators can be obtained only by the standardization and correlation of test methods and related procedures. This is particularly true of methods of conducting mechanical tests of wood, because the mechanical properties are affected by a large number of factors. Correlation is made difficult because the broad field of timber mechanics research includes studies and tests having many different objectives, involving different sizes of material and different matching methods and testing techniques. Adding to this difficulty is the fact that certain diverse methods and practices are already extensively used and practiced.

It is obvious that, if the combined efforts of all research agencies are to be of greatest value by contributing comparable data to an accumulative library of the forest timbers of the world, standard or correlated test procedures should be used as far as possible. In the Americas alone, there are thousands of different tree species, on many of which, particularly those from the tropical regions, little, if any, scientific information is available. Recognition of this situation has led, through the years, to efforts aimed at standardizing and correlating methods of testing wood and wood-base materials both nationally and internationally—particularly, methods for testing small, clear specimens free from defects for the purpose of comparing the properties of various species. This is, however, but a concrete example of one of many problems for international discussion.

Other important subjects in the field of mechanical wood technology include harvesting, processing, methods of testing structural timbers, methods of testing veneer, plywood, and modified woods, methods of testing fiberboards, methods of structural grading, methods of sampling and analysis, methods of conditioning of material, methods of preservative treatment, nomenclature and definitions, joints and fastenings, building construction, structural requirements, general engineering construction, industrial and factory uses, glued-laminated construction, and uses such as poles, railway ties, and mine props.

Two General Testing Systems in Use:

The principal efforts of international conferences in the field of mechanical wood technology have so far been directed toward developing agreements with respect to methods of testing small clear specimens of wood. Two separate systems have been employed. One system employs specimens 2 by 2 in. in cross-section; it is used in the United States, Canada, and a number of other countries (A.S.T.M. Standard Methods D 143 – 49). The other employs specimens 2 by 2 cm. square, and has been used largely in Continental Europe (Monnin method). Associated with the methods used in the United States is the development of a related procedure yielding comparable results from specimens 1 by 1 in. in cross-section.

HISTORICAL BACKGROUND

Since 1909 when the Forest Products Laboratory was established by the U. S. Forest Service at Madison, Wis., in cooperation with the University of Wisconsin, all the timber testing research being carried on at various places by the Forest Service has been centralized at that laboratory. This marked the beginning of the extensive research program of the Forest Products Laboratory to determine, under a comprehensive plan employing standard testing methods, the properties of the different species of wood grown in the United States. As the interest in methods of testing increased, the standard methods employed were adopted by the A.S.T.M. as Standard Methods of Testing Small Clear Specimens of Timber (D 143 – 49).

Progress in forest products research increased over the years as the possibility for accomplishment became apparent. Simultaneously, interest increased, both nationally and internationally, in timber mechanics research. As other laboratories were started, much consideration was given to the development of test methods, and in a number of countries similar methods are now employed. For example, the Forest Products Laboratories of Canada and the United

States Forest Products Laboratory have been using similar methods for testing small, clear specimens since they were organized, so that their data are directly comparable and can be used interchangeably. Other countries, including England, Union of South Africa, Australia, New Zealand, Malaya, and India, have also used, at least in part, generally similar procedures. Under the systematic methods developed, comparable data have now been obtained at the United States Forest Products Laboratory for some 200 species of wood and, in order to continue the accumulation of comparable results, it is desirable that similar test procedures be continued.

In Continental Europe tests are made on small clear specimens varying in size in different countries and also varying with the purpose of the test. Perhaps most used in Europe, and particularly in France, has been the Monnin method employing specimens 2 by 2 cm. in cross-section and test procedures that are in some respects basically different from those used in the United States, Canada, and elsewhere.

International Standardization

One of the broad international problems arising from these differences in practice among different countries has been that of establishing, within the limits of present practices, agreements on broad principles of test methods, initiating studies to develop improved methods, and inaugurating research to establish, as far as possible, conversion factors for comparing results obtained by present differing methods.

Five international conferences, attended by delegates from a number of the most interested countries, have been held since 1937.

The first conference was held in Princes Risborough, England, in 1937, under the auspices of the Timber Research Committee of the International Union of Forest Research Organizations. Consideration was given to questions such as the face of the specimen to which the load is applied, the span-depth ratio to be employed in bending, and the speed of testing. The Conference emphasized the need of additional information on how various factors affect test results, as a basis for reconciling differences in practices and establishing improved procedures.

A second International Union of Forest Research Organizations Conference was held at Princes Risborough in 1939. During this conference agreement was reached on a number of factors, and study of others was recommended.

International conferences, interrupted during the war, were resumed under the auspices of the Food and Agriculture Organization of the United Nations, through its Committee on Mechanical Wood Technology. At a conference held at Geneva, Switzerland, in 1948, detailed consideration was given to the further unification of test procedures. A number of agreements were reached that were embodied in resolutions adopted by the conference.

A fourth international conference, comprising largely representatives from the British Commonwealth of Nations and the United States was held at Ottawa, Can., and Madison, Wis., in the fall of 1948. Out of this conference came a number of agreements that were effective in developing still closer international agreement on testing methods.

1949 Geneva Conference

This report covers in detail the International Conference on Mechanical Wood Technology held August 29–September 3, 1949, at Geneva.

Agenda:

The Agenda for the meeting included the mechanical testing of wood, physical and mechanical testing of such by-products as fiberboard, plywood, laminated wood, and modified wood, standard grading of timber, and economy in the use of wood in building construction, as well as reports on the progress of FAO work. As in the previous conference, however, the principal discussions of results were limited to the field of physical and mechanical tests. The best concept of the work of the committee can be gained from the resolutions adopted as follows:

RESOLUTIONS[2]

Methods of Testing Small, Clear Specimens of Wood

General

Interchange of Information:

1. The Conference recognizes that the general advancement in the standardization of methods of tests will be implemented by the further and continuous interchange of data and information on the subject, and recommends that special efforts be made to facilitate the acquisition and exchange of such information, including the results of tests made by standard methods.

Identification and Selection of Test Material:

2. The botanical identification of test material should, wherever possible, be authentically established.

3. Careful consideration should be given to the selection of test material; in particular, use should be made as far as possible of recognized statistical methods.

Conditioning of Test Specimens:

4. The Conference recommends that tests on small, clear specimens of wood in a dry condition preferably be made on specimens seasoned uniformly to a moisture content as near to 12 per cent as possible, and within the range of 9 to 15 per cent, based on weight when oven-dry.

5. The material should be conditioned so that the moisture is uniformly distributed throughout the specimen, without the presence of appreciable moisture gradient or case hardening.

6. Conditioning facilities are desirable to aid in bringing the test specimens to the 12 per cent moisture content recommended as desired practice, to aid in reducing moisture gradient and to aid in minimizing the range of moisture content over which moisture-strength adjustments must be made.

7. The Conference recognizes that different species of wood differ in their equilibrium moisture content, and that this characteristic may be a factor in the evaluation of the properties and in the use of the wood.

8. The test results should be adjusted to 12 per cent moisture content for presentation.

9. Whenever possible, conversion factors for making moisture-strength adjustments should be presented.

Determination of Moisture Content:

10. In addition to the desirability of storing and testing specimens under standard conditions of temperature and relative humidity, the moisture content of both green and dry test specimens should be determined after each test. The temperature of the drying ovens should preferably be 103 ± 2 C.

Size of Test Specimens:

11. The Conference recommends that, for tests of small, clear specimens, the test specimens shall be taken from pieces square in cross-section, and the cross-sectional dimensions shall be 2 by 2, 2.5 by 2.5, or 5 by 5 cm.

Control of Temperature During Test:

12. The Conference, in recognition of the significant effect of temperature on strength, recommends that, as far as possible, tests be made within the temperature range of 20 ± 3 C.

Rate of Loading:

13. The Conference recommends that all static tests be made at a constant rate of movement of the movable head of the testing machine, and at such a rate that the maximum load is reached in not less than 2 nor more than 5 min.

Accuracy of Equipment and Measurement:

14. The Conference recommends that

[2] These resolutions have been rearranged editorially to bring together related material without altering in any way the intent, or meaning, of the original text. The desirability of such rearrangement was recognized by the drafting committee of the Conference, but sufficient time was not available to complete this task.

all tests be conducted on regularly calibrated machines having an error in the usable working range not greater than ±1 per cent.

15. Dimensions of test specimens should be determined to an accuracy of ±0.3 per cent, and weights to an accuracy of ±0.2 per cent. Where dimensions are to be used solely for the determination of stresses, an accuracy of ±0.5 per cent will be satisfactory, but it should be noted that density is frequently determined from the same measurements.

16. Dimension measurements for shrinkage determinations should be accurate to ±0.05 per cent.

Preservation of Data:

17. The Conference recommends that, in reporting test results for comparison of species, complete information be given on such essential features as the test methods used, the source of the material, the number of tests, moisture content at time of test, density, rate of growth, and other physical characteristics of the material. The temperature of the specimens at time of test shall in all instances be indicated, and a statement given as to whether temperature-strength adjustments have been made, and if so, the correction factor used.

18. The Conference recognizes the desirability of employing statistical methods, wherever possible, for the interpretation of test data. It is suggested that the minimum desirable information to be presented should be the number of observations, the mean, and the standard deviation. The standard deviation should be quoted to three significant figures and the mean value to the same number of decimal places. Where it is desired to investigate relationships between properties, regression and correlation techniques should be employed.

Departures from Recommended Practices:

19. The Conference recommends that, when departures are made from the practices and procedures recommended, such departures be clearly indicated, along with the results of the test.

Shrinkage in Volume Determinations

20. The Conference recognizes that shrinkage-in-volume is affected by a number of factors, including size of specimen and rate and condition of seasoning, and that calculations of volumetric shrinkage from data on radial and tangential shrinkage may be greatly in error. Particular consideration should be given to these factors in the determination of volumetric shrinkage.

Compression Parallel to Grain

21. The Conference recommends that the length-breadth ratio of the compression-parallel-to-grain test specimen be within the range of 2 to 4. If buckling is evident when testing specimens, a lower ratio should be used within this range.

22. The Conference recommends that special care be used in preparing the compression-parallel-to-grain test specimens to insure that the end-grain surfaces will be parallel to each other and at right angles to the longitudinal axis, and that, if deemed necessary, at least one platen of the testing machine be equipped with a spherical bearing.

23. The Conference recommends that, when determining the proportional limit and the modulus of elasticity in the compression-parallel-to-grain test, the compressometer be centrally located and that the knife-edges or contact points be placed sufficiently away from the bearing surfaces of the test specimen to insure that the measurements made relate to a zone of uniform stress condition within the specimen and are not affected by end conditions.

24. The Conference recommends that for each test the manner of failure be observed and recorded.

Static Bending

25. The Conference recommends that the static bending test be conducted on specimens having a span-depth ratio of 14.

26. The Conference recommends that center loading be used for the static bending test and that the surface of the loading block be of curved form with a radius at the center of not less than $\frac{1}{10}$ of the test span.

27. The Conference recommends that the specimen be supported at the end in such a manner as to provide adequate bearing area, and freely to permit the ends of the specimen to change slope and to move longitudinally. It was agreed also that the bearing plates shall be of a length equal to the depth of the specimen, and be centered over the supports.

28. The Conference agreed that the load shall be applied to the radial face of the specimen.

29. The Conference recommends that for each test the manner of failure be observed and recorded.

30. The Conference recommends that, when other than the $S = Mc/I$ formula is used in calculating the result of the static bending test, a statement to this effect be made and the appropriate factors for converting the results to those obtained by the above formula be given.

S = unit stress,
M = bending moment,
c = distance from extreme fiber to neutral axis, and
I = moment of inertia.

31. The Conference recognizes that the modulus of elasticity as determined in the static bending test with central loading on specimens having a span-depth ratio of 14 is not the true modulus but rather an apparent value somewhat lower than the true modulus because of shear deformations. The Conference recognizes also that the true modulus can be estimated closely from the test results. Where precise direct results are required, they may be obtained from a static bending test with four-point loading or by other methods.

Compression Perpendicular to the Grain

32. The Conference recommends, for specimens 5 by 5-cm. in cross-section, the following procedure for the compression-perpendicular-to-grain test:

33. The test specimens shall be 5 by 5 cm. in cross section, and 15 cm. long. The actual height, width, and length shall be measured.

34. *Loading.*—The load shall be applied through a metal bearing plate 5 cm. in width, placed across the upper surface of the specimen at equal distances from the ends and at right angles to the length.

35. *Placement of Growth Rings.*—The specimens shall be placed so that the load will be applied through the bearing plate to a radial (quarter-sawed) surface.

36. *Speed of Testing.*—The load shall be applied continuously throughout the test at a rate of motion of the movable crosshead of 0.3 cm. per min.

37. *Load-compression Curves.*—Load-compression curves shall be taken for all specimens up to 0.25 cm. compression, after which the test will be discontinued. Compression shall be measured between the loading surfaces.

38. Deflection readings shall be taken to 0.00025 cm.

39. *Weight and Moisture Content.*—The specimens shall be weighed immediately before test, and after test a moisture section approximately $2\frac{1}{2}$ cm. in length shall be cut adjacent to the part under load.

Tension Perpendicular to Grain

40. The Conference recognizes that the tension-perpendicular-to-grain specimen employed in the Monnin and A.S.T.M. methods is affected by nonuniform stress distribution but recommends that these methods be continued and that further studies be made to establish conversion factors between methods and to explore other possible methods that promise more nearly pure tensile stress. Accordingly, the procedures described in the original standards NFB 51-010 and A.S.T.M. D 143 – 49 can be employed directly.

Cleavage

41. The Conference recommends the existing cleavage test methods of Monnin and A.S.T.M. as acceptable standards. Accordingly, the procedures described in the original standards NFB 51-011 and A.S.T.M. D 143–49 can be employed directly.

42. It is recommended that conversion factors between the two methods be established in so far as possible.

Tension Parallel to Grain

43. The Conference gratefully acknowledges the report by Mr. Kühne of Switzerland on the special study of Tension Parallel to Grain, made in accordance with the assignment delegated at the 1948 meeting of the Subcommittee on Mechanical Wood Technology.

44. The Conference recommends that only tension-parallel-to-grain test methods should be used that produce fractures within the minimum cross-section and that are applicable to all species and all moisture content conditions.

45. That test specimens should preferably be formed from material of cross-

section conforming to the basic dimensions 2 by 2, 2.5 by 2.5, or 5 by 5 cm.

46. That the radial dimension of the test specimen at the minimum cross-section should be larger than the tangential dimension.

47. That the minimal cross-sectional area should be within the limits of 16 ± 4 per cent of the basic cross-sectional area.

48. That the total length of the test specimen should not be less than 25 cm. (basic dimensions 2 by 2 cm.), 30 cm. (basic dimension 2.5 by 2.5 cm.), or 60 cm. (basic dimension 5 by 5 cm.), and that the minimum length with constant minimum cross-section of 5, 6, and 12 cm., respectively, should be provided to enable deformation measurement.

49. That grips designed to prevent slip of the specimen during the test be used, and that articulation and centering of the grip installation be provided to ensure axial loading of the test piece.

50. That deformation measurements be made in the middle of the portion having minimum cross-section, and that the gage length be not longer than half the length of the minimum permissible cross-section zone.

51. That for each test the manner of failure be observed and recorded.

Impact Bending

52. A progress report was submitted by Mr. Markwardt on the special study of impact bending undertaken in accordance with the assignment delegated at the 1948 meeting of the Subcommittee. The Conference recommends that the study be completed and that recommendations for consideration of the Conference be submitted at the next meeting.

53. The resolutions of the 1948 meeting of the Subcommittee on Mechanical Wood Technology with respect to impact bending were reviewed and confirmed as follows:

54. "*Pendulum Type.*—The committee recognizes that the Monnin impact test is widely used and affords an acceptable method of meeting the general requirements of an impact test. The Izod method and the U. S. Forest Products Laboratory toughness machine are also utilized. It is recommended that efforts be made to establish correlation of results between the various machines in so far as possible.

55. "The committee recognizes that pendulum impact machines should be so constructed that the pendulum strikes the specimen at the center of percussion.

56. "The committee recommends that impact tests with the pendulum type machine be made on specimens 2 by 2 cm. in cross-section, and a span-depth ratio of 12. The results should be expressed in terms of energy absorbed by the specimen.

57. "*Vertical Drop Type.*—The committee recognizes that the Hatt-Turner type of impact machine affords a method which has been long in use for testing specimens 5 by 5 cm. in cross-section.

58. "*General.*—The committee recommends that impact test specimens be loaded on the radial face.

59. "The committee recommends for each test that the manner of failure be observed and recorded."

Shear Parallel to Grain

60. Mr. Markwardt reported progress on the special study of shear testing methods, of which a large number have been examined and recorded, work on which was undertaken in accordance with the assignment delegated at the 1948 meeting of the Subcommittee. The Conference recommends that the study be continued and completed and that recommendations for consideration of the conference be submitted at the next meeting.

Abrasion

61. The Conference realizes that, from the point of view of the standardization of an abrasion test, there is a notable difference in probable usability among the machines to which attention has been drawn by Mr. Bienfait.

62. The following five abrasion machines can do no more than give a simulated service test, and they are therefore considered as special tests.

An apparatus of composite nature developed at Forest Products Research Laboratory, Princes Risborough (England).
An apparatus along the lines of Tinius Olsen's testing apparatus.
The Kollmann apparatus.
The Amsler apparatus.
The apparatus in development at the Central Institute for Testing Materials at Delft (Holland).

On the other hand, the Taber apparatus and the Graselli apparatus for abrasion testing are usable for determining abrasion as a characteristic of the material. The Conference therefore recommends that the study be continued with the latter type and that eventual new developments should be included.

Fiberboards

63. The Conference acknowledges with thanks the report by Mr. Markwardt on proposed methods for testing fiberboards, representing detailed procedures for a number of tests that have been under review and development for the last two years. It recognizes the complex nature of this subject, and the need of establishing methods for additional tests, such as impact resistance. In view of the inadequate time of the delegates to study in detail the methods presented by Mr. Markwardt, the Conference recommends that the study be continued, and that the services of certain other delegates be enlisted to assist in this project, as follows:

Mr. Markwardt—United States
Mr. Brauns—Sweden
Mr. Collardet—France
Mr. Jenkins—Canada
Mr. Latham—England

64. The functions of the study committee are to determine the scope of application of the methods with respect to types of material, the kind of tests to be standardized, and the procedures to be used for each with respect to sampling, and method of test.

Additional Special Study Assignments

65. In order to carry forward still further the work of the conference with respect to methods of testing and interpretation of data, further special study assignments were made on which reports are to be given to the conference at some forthcoming meeting, as follows:

Moisture-Strength Relations

66. To study presently available data on the relation of moisture to strength, review present practices used for moisture-strength adjustments, appraise areas of needed research to augment present data, conduct further studies, and report on the findings and conclusions.

Mr. Travnik—Czechoslovakia.

Cleavage and Tension Perpendicular to Grain

67. To study further the presently used test methods for tension perpendicular to grain, to explore possible new test methods; and for such new practical methods as give promise of improved stress distribution, to conduct tests for comparison with present methods, and for comparison with the results of cleavage tests.

Mr. Bienfait—Holland
Mr. Cooper—Australia
Mr. Kühne—Switzerland
Mr. Markwardt—United States

Timber Grading

68. The Conference recognizes the great difficulties encountered in the attempts to standardize commercial grades and sizes of sawn timber among the various countries, resulting from well-established trade rules, and differences in growth structure and characteristics among the various species involved. The Conference believes, however, that substantial progress could be made in summarizing the basic principles of structural grading essential to economical and efficient engineering use of timber and recommends that a study be made of the definitions of terms and that in so far as possible principles of structural grading be established that can be generally applied to all species.

69. The Conference recommends that a special study Committee be established to carry forward this program, with the following assignments:

Mr. Siimes—Finland
Mr. Campredon—France
Mr. Dahlquist—Sweden
Mr. Jenkins—Canada
Mr. Kühne—Switzerland
Mr. Latham—England
Mr. Markwardt—United States
Mr. Travnik—Czechoslovakia

70. The Conference recommends that the Committee study the already well-established structural grading rules employed in several countries, and study the possibility of establishing a limited number of universal structural grades.

Nomenclature

71. The Conference believes that it is possible to reach a certain degree of generalization and simplification of the nomenclature of commercial woods to the end that possibly one or not more than a few commercial designations will be needed to identify each species.

72. The Conference therefore entrusts the Secretariat of FAO with the task of compiling and reconciling the official and already established nomenclatures that have been developed by competent organizations in a number of countries, and invites the following members to establish a list of designations which could be usefully generalized:

Mr. Collardet—France
Mr. Bienfait—Netherlands
Mr. Fouarge—Belgium
Mr. Tortorelli—Argentine
Mr. Wright—Australia

73. The nomenclature to be established should give, besides the designations recommended, the botanical names, the average gravity and range of specific gravity, preferably at 12 per cent moisture content, and all other information that would be deemed necessary to facilitate the choice of eventual end uses.

Veneer, Plywood, and Allied Materials

74. To draft a standard scheme of testing for veneer, plywood, and allied materials, taking into consideration the comprehensive American method as presented in A.S.T.M. Standard Method D 805–47 as a basis for discussion, taking into account also the methods in other countries, including aircraft and navy specifications; also to consider the possible establishment of a list of definitions and terms relating to veneer and plywood.

Mr. Latham—England
Mr. Collardet—France
Mr. Gordon—Australia
Mr. Jenkins—Canada
Mr. Markwardt—United States
Mr. Thunell—Sweden

Meetings of Study Committees

75. The Conference recognizes the difficulty encountered by the study committees in reaching agreements and completing assignments by correspondence only, and therefore recommends that, just prior to the next plenary conference, several days be allowed for the scheduling of meetings of study committees. In addition to facilitating the work of the study committees and enhancing their progress, such procedure should also greatly shorten detailed discussions in the plenary meeting. The Conference recommends also that announcement of meetings scheduled for the study committees and for the plenary conference be made well in advance and preferably not less than 6 months ahead.

Acknowledgments

76. The Conference wishes to express its special gratitude to its Chairman, Monsieur Campredon, for the amiable and very capable manner in which he conducted the meetings, and to Mr. Markwardt, who in such a remarkable manner has kept the many and complicated records of the meetings, so that at the end of a full week's session a complete summary of the Committee's resolutions was ready for its consideration and approval.

77. The Conference wishes also to record its appreciation for its several members who, in the fulfillment of their assignments, prepared and presented reports, and to those who in any manner contributed with their expedience to come to a fulfillment of the aims of the 1949 session.

Technical Bases for Future Agreements

The progress of the Conference must depend largely on technical data as a basis for reaching conclusions and agreements. To cover subjects in the present agenda where available data are inadequate or lacking, it may be noted that a number of study committees were appointed by the Conference to report at a later meeting.

It is evident from the resolutions adopted that considerable progress has already been made, particularly in the field of procedure relating to methods of testing small clear specimens of wood and wood-base materials. This gives hope of further progress in international agreements in the field of mechanical wood technology. It should be repeated, however, that such progress is contingent on the availability and development of technical information as a basis for improved practices, agreements, and decisions.

Delegates in one section of conference room, Palace of Nations, FAO Conference on Mechanical Wood Technology, August 29 to September 3, 1949.

(See full illustration of delegates also on page 40 of this BULLETIN.)

Some of the delegates around the table from left to right are: John H. Jenkins, Forest Products Laboratories of Canada; Mr. L. J. Markwardt, U. S. Forest Products Laboratory, U.S.A.; Hellmut Kühne, Federal Materials Testing Laboratory, Switzerland; (unidentified); Bertil H. Thunell, Forest Products Research Laboratory, Wood Technical Department, Sweden; Gunnar F. Dahlquist, Joint Building Committee, Stockholm, Sweden; Otto Brauns, Swedish Work Research Institute (across from Mr. Markwardt). The two members nearest the camera are unidentified, as well as the three men farthest from the camera.

Proposed Modification of the Kauri Reduction Test

Report by Flexibility Group Subcommittee IX, A.S.T.M. Committee D-1[1]

FLEXIBILITY of varnishes may be measured either by directly determining the distensibility of dried films cast and air dried under standard conditions (1)[2] or by determining the amount of dilution of a standard kauri-gum solution which may be added to a given varnish which, when subsequently applied to tin plate baked in an oven under prescribed conditions, will resist cracking when bent over a mandrel of stated diameter.

The former method is probably the most accurate known but is time consuming, requiring about ten days to two weeks for completion, while the latter, known as the standard A.S.T.M. kauri reduction test as described in A.S.T.M. Method D 154,[3] is subject to many errors mainly due to lack of uniformity of the prepared kauri solution and its instability upon aging (2).

As originally conceived by its originator, V. M. Pulsifer, the "Kauri Test" was considered to be a measure of the outdoor durability of a varnish. Since "oil length" and durability were tied together it became an approximate measure of the oil length of a varnish. However, with the advent of synthetic resins, oil length and flexibility were no longer synonymous and the kauri test became a measure of flexibility (3, 5, 6).

There have been considerable differences of opinion relative to the accuracy and the exact interpretation of the kauri test in the literature, and other tests have been proposed from time to time (4). Some work was also done on alkyds which seemed to respond to the kauri test like oleoresinous varnishes (7).

Because of the general desire among the members of A.S.T.M. Committee D-1 on Paint Varnish, Lacquer, and Related Products to obtain either a more direct method of determining flexibility of varnishes or an improvement of the standard kauri test,[3] Subcommittee IX on varnish appointed a group to look into this possibility. This group first made a preliminary survey in trying to find a faster direct flexibility test than by measuring the elongation of air-dried films. They tried the baking of varnish films applied on tin foil, for 5 hr. at 208 F. in an oven, after which the film was placed horizontally between the jaws of a tension testing machine, the tin foil removed by placing mercury beneath the film so that it would touch, after which the elongation of the film was taken.

It was found, after several tests on various varnishes, that no good correlation could be found between the elongation obtained and the oil length of the varnish or the kauri reduction value.

It was, therefore, determined to try to find some more stable and uniform resin solution or method of producing same, to substitute for the kauri gum solution in the standard kauri reduction test. Some refinements of the method were also worked out to increase its accuracy.

The selection and method of producing the resin used in the proposed "new" resin solution were arrived at by trying out many types of synthetic resins with the knowledge that:

(1) It must be duplicated to specification readily, (2) it must be compatible with many types of varnishes, (3) it must resist change due to oxidation, and (4) it must have the necessary hardening property on varnish films to duplicate the action of run-kauri.

It was found that these conditions were most readily met by employing a pentaerythritol rosin ester solution in high-flash naphtha. This solution is made up as follows:

ESTERIFICATION

Heat 3 lb. "WW" rosin (melting point—173 to 177 F.; acid number—165 to 167) in a three-necked glass balloon flask heated by a three-ring conventional gas burner capable of generating 12,000 Btu.'s per hr.; the three-liter glass balloon flask shall be equipped with a motor-driven stirrer and agitator with a blade peripheral speed of 600 ft. per min. The propeller should be of the three-bladed type with the blade $\frac{3}{4}$ in. in width and the propeller $1\frac{3}{4}$ in. in diameter. The agitator passes through a loose cork stuffing box in the center neck of the flask. A thermometer, 16 in. in length, reading from +20 to +760 F., meeting A.S.T.M. designation E1-47[4] (3F-39) requirements, shall be used with a cork fitting in one side neck of the flask while the carbon dioxide lead-in is fitted through a cork stopper in the other side neck of the flask. The carbon dioxide lead-in should be connected by a rubber tube from the adjustable reducing valve on the pressure cylinder and lead below the surface of the reacting liquid through a constricted glass tube. When the temperature of the rosin reaches 450 F., start the motor stirrer, adjust the pressure reduction valve on the carbon dioxide cylinder so that about two bubbles of the carbon dioxide will break to the surface per second. With the temperature at 450 F. add 0.33 lb. pure pentaerythritol (49.5 per cent hydroxyl content; less than 0.2 per cent ash content; melting point—250 C.) by raising the cork stuffing box on the agitator shaft from the center neck of the flask. With the agitator running, transfer the pentaerythritol in small amounts to the contents of the flask. The size of the hole in the cork accommodating the agitator shaft shall be large enough to allow the escape of carbon dioxide and water vapor from the reaction flask and prevent any pressure build-up in the flask.

Heat the contents of the flask to 600 F. and hold at that temperature until the solid-resin has an acid number of 8.0 and a melting point of 261 to 265 F. by the A.S.T.M. ball-and-ring method.[5] (The time required is about $6\frac{1}{2}$ hr. at this temperature.) When the resin reaches the correct characteristics as shown above, turn off the heat, allow the carbon dioxide to continue until the flask cools to a temperature of 400 F., after which pour the liquid resin into a tared container and make up to $33\frac{1}{3}$ per cent resin concentration in high-flash solvent naphtha[6] of the following characteristics:

Type Solvent—aromatic
Color—water-white
Distillation Range—first drop not below 150 C.
Dry Point—not above 193 C.
Acid Wash—not darker than No. 10 by A.S.T.M. Method D-848.[7]

This procedure shall be followed very accurately and after dilution the resin solution shall be stored in tightly corked amber glass bottles.

PENTA-ROSIN-ESTER SOLUTIONS

As a matter of interest we are submitting below (Table I) a series of penta-

[1] The membership of this group (1947–1948) follows: S. C. Robison (*Chairman*), The Thibaut and Walker Co.; W. R. Fuller, Grand Rapids Varnish Co.; C. C. Hartman, U. S. Bureau of Standards; C. C. Hipkins, Bell Telephone Laboratories; H. C. Parks, The Valspar Co. (now with the E. and F. King Co.); S. H. Richardson, Bakelite Corp.; L. F. Wagner, Glidden Co., A. Wilhelm Division.

[2] The boldface numbers in parentheses refer to the list of references appended to this paper.

[3] Standard Methods of Testing Varnishes (D 154 – 47), 1947 Supplement to Book of A.S.T.M. Standards, Part II, p. 171; also 1949 Book of A.S.T.M. Standards Part 4.

[4] Specification for A.S.T.M. Thermometers (E 1 – 47), 1947 Supplement to Book of A.S.T.M. Standards, Part II, p. 238; Part III-A, p. 370; Part III-B, p. 268.

[5] Tentative Method of Test for Softening Point (Ball and Shouldered Ring Apparatus) (E 28 – 42 T) 1946 Book of A.S.T.M. Standards, Part II, p. 1679; Part III-A, p. 1224; Part III-B, p. 1303; also 1949 Book of A.S.T.M. Standards, Parts 3 to 6.

[6] Referred to hereafter as high-flash naphtha.

[7] Standard Method of Test for Acid Wash Color of Benzene, Toluene, Xylenes, Refined Solvent Naphthas, and Similar Industrial Aromatic Hydrocarbons (D 848 – 47), 1946 Book of A.S.T.M. Standards, Part III-A, p. 991; also 1949 Book of A.S.T.M. Standards, Part 5.

Specific Gravity at $15\frac{1}{2}$ C.—0.855 to 0.890.
Flash Point, Tag, open cup—105 F.

TABLE I.—DEVELOPMENT OF PENTA-ROSIN-ESTER SOLUTIONS EMPLOYING DIFFERENT RAW MATERIALS IN MAKEUP.

	Composition	Solid Ester				Comparative Kauri Reduction Tests		
		Acid Number	Melting Point deg. Fahr.	Body	Color	Varnish No. 3	Varnish No. 5	Varnish No. 8
I	"N" gum rosin acid No. 163.3 Columbia naval stores Pure pentaerythritol	7.9	261.75	A-5	11–12	55	90	160
II	"N" gum rosin acid No. 163.3 Columbia naval stores Technical Grade pentaerythritol	7.9	264.1	A-5	11–12	55	90	160
III	"WW" gum rosin acid No. 165 Florida Oil and Chem. Corp. Technical Grade pentaerythritol	8.0	268.3	A-5	9–10	55	85	160
IV	Nelio "WW" rosin acid No. 166.6 Southern Paint and Chem. Co. Technical Grade pentaerythritol	8.0	272.6	A-5	9–10	55	90	160
	Straight kauri solution Am. Gum. Imp. Assn. For comparison of body and color	...	...	A-4	17–18			

rosin-ester solutions which were made up using different rosins and different grades of pentaerythritol to show how we arrived at the preferred method of preparation.

The results in Table I show that there is relatively little difference in the type of rosin used. Likewise, very little difference is discernible between the pure pentaerythritol and the technical pentaerythritol in so far as the final acid number and melting point of the resin or the body and color of the solution were concerned.

Likewise, the actual runs on flexibility using the standard kauri reduction procedure but employing the penta-rosin-ester solutions shown in the table gave very little in the way of variation, and for this reason it was felt that the method of preparing the resin solution was rather simple and easily duplicated.

In this connection, it should be pointed out that the substitutions of high-flash naphtha for turpentine in the preparation of the solutions eliminated error due to the polymerization of turpentine on standing.

Plan of Test

Ten varnishes were made up of different types and oil lengths commonly encountered and sealed in pint cans. One pint of each varnish was sent to each of the seven collaborators on the committee, with the plan of test being to make up the proposed penta-rosin-ester solution, also the standard kauri solution and run the comparative reductions of each of the ten varnishes while the solutions were freshly made.

The second part of the test entailed preserving the test solutions prepared above in tightly sealed glass bottles and repeating the reductions on a second series, one year later, of the same ten varnishes kept sealed in full pint cans during this period.

Discussion of the Test Data Employing Fresh Test Solutions

The data shown in Table II represent the completion of the first half of the program. It is unfortunate that in a few instances group members ran out of test varnishes before completing their tests and in such cases results were inconclusive. It is indicated in the tables where such results were obtained. These were omitted in calculating the average values.

The committee members were asked to make their kauri reduction tests 5 per cent apart, but some used the A.S.-T.M. interval of 10 per cent. However, in all cases, the passing figure given before the failing figure was employed as the kauri reduction value. Obviously, a 10 per cent interval might register a lower kauri reduction value by 0 to 5 per cent as compared with a 5 per cent interval.

Collaborator *D* reported two types of bending tests:

1. Those run by bending the strips by machine (**8**).
2. Those run by bending by hand in approximately one second.

Apparently a large discrepancy occurs in bending by the two methods. Collaborator *D* obtained the lowest of all run-kauri values by his machine tests. On the other hand, his machine tests on the penta-rosin-ester solution gave results close to the average obtained by the whole group. Thus there is shown the necessity for uniformity in rate of bend.

In reporting values, the passing and failing interval is reported for convenience in a rather conventional manner. Thus, 65 over 70 would indicate passes 65 and fails at 70 per cent.

It may also be stated that the plotted positions of the graphical results of the run-kauri tests and the penta-rosin-ester tests show less extreme of the values in the latter case; in other words, a more compact grouping is shown. This points very favorably to the possibility of the penta-rosin-ester being superior to kauri in the kauri reduction test by contributing to more uniform results.

"Average" Comparison

The average of the values reported for each varnish under the run-kauri test as well as the penta-rosin-ester test was calculated. In this calculation all inconclusive values were left out. It is unfortunate that those figures were not available as they would have rendered the averages more accurate. There is, however, surprisingly good agreement (average) between the run-kauri and the penta-rosin-ester tests. These results are very encouraging and a comparison with the results at the end of the second test period indicates fairly close agreement through the series.

The following represents the tabulated results by all members of the committee on their initial test period representing the ten varnishes with fresh solutions. This is followed by a graphical representation of the values obtained in this table for both the standard kauri solution and the proposed penta-rosin-ester solution, together with the average of the values in each group compared with each other.

Second Period Tests

In accordance with the plan of running the kauri tests employing both the standard kauri solution and the penta-rosin-ester solution after aging for one year, the committee arranged to re-run the same set of varnishes which had been distributed a second time in full, sealed containers for this purpose. They, likewise, preserved their test solutions in sealed glass bottles.

The object of this test run was to determine:

1. Whether any change occurred in the results reported in the first test.
2. Whether the change was due to some physical or chemical change in either the kauri solution or the penta-rosin-ester solution.
3. Whether there was a change in values due to effect of age on the varnish itself.

The data in Table III represent the results of the second round of tests employing solutions one year old. The results shown in the table superimposed on a graph will give a clear idea of the grouping of results and the variation or range obtained by each of the co-workers.

TABLE II.—RESULTS OF INITIAL TEST PERIOD (1947) USING FRESH TEST SOLUTIONS.

Varnish	Type Varnish	Oil Length, gals.	Solids, per cent	Standard A.S.T.M. Kauri Test								Proposed Penta-Rosin-Ester Solution							Average	
				A		B	C	D		E	F	A	B	C	D		E	F	Kauri Solution	Penta-Rosin-Ester Solution
				American Gum	Bureau of Standards			Machine Test	Hand Test						Machine Test	Hand Test				
No. 1...	Maleic, Linseed, Wood Oil	13	50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
No. 2...	Limed Rosin, China Wood Soya	17	54	100 105	90 95	85 a	85 90	65 75	75 80	80 85	70 75	100 105	85 a	80 85	80 85	95 a	80 85	75 80	80.7	83.0
No. 3...	Ester Gum, Linseed, China Wood Soya	25	57	75 80	80 85	55 60	60 65	50 55	60 70	55 60	55 60	75 80	55 60	60 65	55 60	60 70	55 60	60 75	61.2	60.0
No. 4...	Limed Rosin, Linseed, China Wood Soya	25	57	80 85	80 85	75 a	75 80	45 55	55 65	70 75	65 70	90 95	75 a	70 75	65 70	75 85	70 75	65 70	70.0	72.5
No. 5...	Limed Rosin, Linseed	28	48	95 100	95 100	95 a	85 90	75 85	75 85	90 95	80 85	95 100	95 a	85 90	90 95	105 a	90 95	80 85	85.0	88.0
No. 6...	Ester Gum, China Wood	31	56	70 75	65 70	65 75	60 65	45 55	55 60	60 65	65 70	75 80	65 75	65 70	65 75	75 a	60 65	55 60	60.6	64.1
No. 7...	Pentalyn, Linseed	40	57	100 105	100 105	105 115	100 105	a 85	95 100	100 105	95 100	100 105	105 115	100 105	100 105	115 a	100 105	90 95	99.2	99.1
No. 8...	Phenol Mod., China Wood, Linseed	75	67	165 170	165 170	165 a	160 165	145 155	175 185	160 165	145 155	165 170	165 a	160 165	175 185	185 a	160 165	160 165	159.2	164.0
No. 9...	Long Oil, Soya, Alkyd	25 per cent Phth.	55	130 135	130 135	120 a	110 115	100 110	140 a	115 120	120 125	130 135	120 a	115 120	120 130	140 a	115 120	125 130	117.5	121.0
No. 10...	Short Oil, Soya, Alkyd	40 per cent Phth.	40	65 70	65 70	60 a	40 45	60 70	60 70	55 60	55 60	65 70	60 a	35 40	60 70	70 80	55 60	55 60	57.1	56.6

[a] Value not reported.

NOTE—The italicized capital letters refer to collaborators as shown: *A*—C. C. Hartman; *B*—L. F. Wagner; *C*—W. R. Fuller; *D*—S. H. Richardson; *E*—S. C. Robison; *F*—H. C. Parks.

TABLE III.—SECOND PERIOD TESTS.

Varnish	Type Varnish	Oil Length, gals.	Solids, per cent	Standard A.S.T.M. Kauri Test—Kauri Solution 1 Yr. Old							Modified A.S.T.M. Kauri Test Using Proposed Penta-Rosin-Ester Solution 1 Yr. Old							Average of Aged Solutions		Average of Fresh Solutions	
				A	B	C	D		E	F	A[a]	B	C	D		E	F	Karui Solution	Penta-Rosin-Ester Solution	Kauri Solution	Penta-Rosin-Ester Solution
							Hand Test	Machine Test						Hand Test	Machine Test						
No. 1..	Maleic, Linseed, Wood	13	50	0 0	5 10	0 0	0 0	0 0	0 0	0 0	0 0	0 5	0 0	0 0	0 0	0 0	0 0	0 0	0.7	0.0	0.0	0.0
No. 2..	Limed Rosin, CWO, Soya	17	54	85 90	80 85	65 70	65 70	65 70	55 60	70 75	85 90	100 115	75 80	95 100	70 75	55 60	70 75	69.3	78.5	80.7	83.0
No. 3..	Ester Gum, Linseed, CWO, Soya	25	57	65 70	75 80	60 65	50 60	40 50	40 45	55 60	70 75	75 80	60 65	65 70	55 60	35 40	55 60	55.0	59.2	61.2	60.0
No. 4..	Limed Rosin, Linseed, CWO, Soya	25	57	75 80	90 95	60 65	65 75	45 50	45 50	65 70	80 85	90 ?	65 70	70 80	70 80	45 50	55 60	63.5	64.1	70.0	72.5
No. 5..	Limed Rosin, Linseed	28	48	85 90	110 115	75 80	75 85	70 75	65 70	80 85	85 90	110 115	85 90	80 90	70 80	60 65	55 60	80.0	77.8	85.0	88.0
No. 6..	Ester Gum, CWO	31	56	65 70	65 70	55 60	55 65	50 55	50 55	65 70	65 70	95 100	65 70	70 75	60 65	50 55	50 55	57.8	65.0	60.6	64.1
No. 7..	Pentalyn, Linseed	40	57	95 100	90 95	95 100	80 90	65 70	90 95	95 100	90 95	120 135	95 100	110 115	80 90	90 95	90 100	87.1	96.4	99.2	99.1
No. 8..	Phenol Mod., CWO, Linseed	75	67	155 160	160 165	150 155	? 145	? 145	150 155	150 155	160 165	195 200	155 160	185 190	? 175	140 145	160 165	153.0	165.8	159.2	164.0
No. 9..	Long Oil, Soya, Alkyd	25 per cent Phth.	55	125 130	135 ?	105 110	110 120	100 110	110 115	120 125	125 130	150 "	110 115	150 155	145 150	110 115	..	111.6	128.0	117.5	121.0
No. 10..	Short Oil, Soya, Alkyd	40 per cent Phth.	40	50 55	70 75	30 35	? 50	? 50	45 50	55 60	45 50	70 75	30 35	65 70	50 55	50 55	..	50.0	51.6	57.1	56.6

[a] Solution only 2 months old.

NOTE—The italicized capital letters refer to collaborators as shown: *A*—C. C. Hartman; *B*—L. F. Wagner; *C*—W. R. Fuller; *D*—S. H. Richardson; *E*—S. C. Robison; *F*—H. C. Parks.

It should be mentioned once more that some of the data were inconclusive due to individuals running out of material before they secured their results and again these values were omitted in the average calculations even though some were reported as partial results (in other words, reported a failure without the passing value or reported the passing value without the failure).

It may be noted from the data in Table III that the proposed modified penta-rosin-ester tests are superior to the run-kauri tests:

1. The penta-rosin-ester average values agree more closely with the average values of both the penta-rosin-ester and the standard kauri solution runs on the initial varnish series where fresh solutions were employed.

2. There is a greater range in values on the second (Table III) test than on the first series. This is not satisfactorily explained and may be due to variation in the results of the operators or changes occurring in the solutions. However, while the variation is over an unexpectedly wide range and brings to light once more the general unsatisfactory nature of the kauri reduction test, it does show that if one considers the averages there is a greater uniformity in the case of the penta-rosin-ester solution tests. Too, it will be observed that the penta-rosin-ester solution, "aged" *versus* "fresh," gives more nearly equal results than the standard kauri solution "aged" *versus* "fresh." This can be verified by superimposing the two graphs representing the average values of kauri, and penta-rosin-ester tests, on fresh *versus* aged solutions. There is a possibility that the general shift to slightly lower average values on the "aged varnishes" may be accounted for partly by the varnish itself developing a lower kauri reduction value upon aging. This possibility should be followed up.

3. There is a drop in the kauri reduction values using both the standard kauri solution and the penta-rosin-ester solutions (aged) but the drop noted is much greater in the case of the standard run-kauri solution than in the case of the penta-rosin-ester solution.

It should be noted here that while penta-rosin-ester values reported by collaborator *A* in the second run were obtained using the solution only two months old, they were, nevertheless, included in the averages.

Conclusions

As a result of the foregoing work the conclusion may be drawn that the penta-rosin-ester solution is superior to the old run-kauri solution in the standard kauri reduction test.

It is also easier to prepare a standard penta-rosin-ester solution than a standard run-kauri solution meeting set requirements or specifications in the former case, whereas in the latter, one is not advised how long the distillation must proceed and for this reason there is a variation in the general character of the run-kauri solution depending upon the time involved, also because it is not always easy to obtain kauri gum, particularly of uniform characteristics, and the reverse is true with respect to rosin and pentaerythritol; any laboratory should be able to prepare without any difficulty the penta-rosin-ester solution in accordance with the simple instructions given earlier in this report.

Although much variation was experienced in the results returned by the various collaborators, the averages confirmed the fact that the "aged" penta-rosin-ester solution more closely paralleled the results obtained with the fresh solution than did the "aged" kauri solution.

Apparently, too, the substitution of high flash naphtha in lieu of turpentine is justified from the foregoing results and verifies the logic of substituting a nonoxidizing solvent for an oxidizing type of solvent.

It was found that due to the rather large dilution of varnishes having high kauri reductions with the test solutions, the product was too thin to apply satisfactorily with a Bird or a Bradley applicator. This was because the solution was so thin that it was merely pushed around and did not stay in place. This was certainly true of the varnishes having high kauri reductions and rather low normal viscosities. For this reason, we saw no other alternative than to adhere to the present A.S.T.M. practice of preparing the panels. The suggestion of concentrating the test solutions was made and possibly could be employed to counteract the viscosity lowering effect. This would entail another "factor" in calculating the kauri reduction, however. We recommend narrowing up on the baking cycle in order to obtain more concordant results and suggest that the oven used be held at 207 to 208 F. We did not change the present curing temperature of 75 F. for 15 min. before bending, but if it were desired to make this 77 F., we see no harm in making this substitution in the present standard method.

The bending of the test panel should be done at a stated rate and we have adopted a bend over the mandrel in one second. Obviously a faster bend would create greater stress and a slower bend would reduce the stress giving variable results.

Preliminary test runs on any samples should be made with rather widely spaced "reductions," say 20 per cent apart, in order to spot approximately the kauri reduction value before attempting to find its value accurately using reductions 10 per cent apart (in this report we recommended using reductions 5 per cent apart to secure greater accuracy).

Having prepared the penta-rosin-ester solution in accordance with the procedure outlined in the first part of this report, the resin reduction method may be carried out as follows:

Proposed Resin Reduction Method

Test Panels

1. Test panels shall be cut from bright tin plate weighing not more than 25 nor less than 19 g. per sq. dm. (0.51 to 0.39 lb. per sq. ft.). It is important that the tin plate shall be within the limits prescribed. The panel shall be about 7.5 by 13 cm. (3 by 5 in.) and shall be thoroughly cleaned with benzene immediately before using.

Note.—Commercial No. 31 gage bright tin plate should weigh about 0.44 lb. per sq. ft. It is important that the rags used in wiping the panels be clean.

Procedure

2. (*a*) *Determination of Nonvolatile Matter in Varnish.*—Pour a portion of the sample of varnish into a stoppered bottle or weighing pipet and weigh. Transfer about 1.5 g. of the sample to a weighed, flat-bottom metal dish (Note 1) about 8 cm. in diameter (a friction-top can cover is satisfactory). Weigh the container again, and calculate by difference the exact weight of the portion of the sample transferred to the weighed dish. Heat the dish with its contents for 3 hr. in an oven maintained at 105 to 110 C. (221 to 230 F.). Cool the dish and contents and weigh again. The ratio of the weight of the residue to that of the sample, expressed as a percentage, shall be taken as the percentage of nonvolatile matter in the varnish.

Note.—A Pyrex or equivalent heat-resistant glass Petri dish 100 mm. in diameter by 10 mm. in depth may be used in place of the flat-bottom metal dish.

(*b*) *Reduction of the Varnish.*—To 100 parts of the varnish by weight, add an amount of the penta-rosin-ester solution equivalent to 50 per cent (Note 2) by weight of the nonvolatile matter in the varnish and mix thoroughly.

Note 2.—The 50 per cent resin reduction is given to illustrate the method. Any other percentage of penta-rosin-ester may be used, depending on what is required of the particular sample being tested.

(*c*) *Application of Reduced Varnish.*—Flow the varnish upon one of the tin panels described in Section 1 and permit the panel to stand in a nearly vertical position at room temperature for nearly 1 hr. Place the panel in a horizontal position in a properly ventilated oven and bake for 5 hr. from 97.22 to 97.77 C. (207 to 208 F.) Remove the panel from the oven and permit to cool at room temperature, preferably 24 C. (75 F.) for 15 min.

Note—The italicized capital letters refer to collaborators as shown: *A*—C. C. Hartman; *B*—L. F. Wagner; *C*—W. K. Fuller; *D*—S. H. Richardson; *E*—S. C. Robison; *F*—H. C. Parks.

(*d*) *Bending the Test Panel.*—Place the panel with the coated side uppermost over a 3-mm. (⅛-in.) rod, held firmly by suitable supports, at a point equidistant from the top and bottom edges of the panel and bend the panel double rapidly, within 1 sec. The varnish shall show no cracking whatsoever at the point of bending. For accurate results, the bending of the panel should always be done at 24 C. (75 F.) and within 15 min. after baking, since a lowering of the temperature will lower the percentage while an increase in temperature increases the percentage of reduction that the varnish will withstand. Allowing samples to stand longer than 15 min. causes variable results due to effect of moisture absorption, humidity, etc.

Report

3. (*a*) Varnishes that do not show cracks under this test shall be reported as passing a 50 per cent reduction, while those which do crack shall be reported as not passing a 50 per cent reduction.

(*b*) The varnishes that have not cracked shall be tested again, changing the amount of reduction to 60 per cent, and, if they pass this percentage of reduction, they shall be tested with a 70 per cent reduction. In a similar manner, varnishes that have cracked at 50 per cent reduction shall be tested again, using reductions of 40 and 30 per cent. In this way the limits shall be determined within 10 per cent at which a varnish passes one percentage of reduction and does not pass the next. For example, varnishes may be reported as passing 40 per cent, and breaking at 50 per cent.

(*c*) Multiple test runs may be made to save time by preparing several samples 10 per cent apart, flowing out, and baking and subsequently bending in the prescribed manner, to cover the range in which the expected "reduction" lies. Obviously the number of samples should not be so large that the variation introduced by time required to bend would be apparent.

NOTE.—It is suggested that 20-g. samples of varnish should be sufficient for each reduction. If the nonvolatile content of the varnish should be 48.6 per cent, then 4.86 g. of penta-rosin-ester solution should be added to the 20 g. of varnish and a 50 per cent reduction will be obtained. Likewise, a 25 per cent reduction would require just one half this amount of penta-rosin-ester solution.

REFERENCES

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(2) G. G. Sward and S. A. Levy, "Uniformity of Run-Kauri," *Circular No. 396*, Scientific Section, American Paint and Varnish Manufacturers Association.

(3) Report of New York Production Club, "Kauri Reduction *versus* Durability of Newer Type Varnishes," *Circular No. 423*, Scientific Section, American Paint and Varnish Manufacturers Association.

(4) S. A. Levy, "Development of a Photo-Chemical Test for Quickly Relating the Durability of Varnishes," *Circular No. 410*, Scientific Section, American Paint and Varnish Manufacturers Association, p. 146.

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(6) J. R. Stewart, "Methods of Evaluating Metal Finishes," *Products Finishing*, Vol. 8, No. 6, pp. 36–40 (1944).

(7) "Kauri Reduction Values of Alkyd Resins," *Circular No. 604*, National Paint, Varnish and Lacquer Association, pp. 395–399 (1940).

(8) S. H. Richardson, private communication. "A device for eliminating the possible variations in bending test strips by hand. Each strip is bent in a machine in exactly the same time and held in exactly the same position with exactly the same support and same bending-force distribution."

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RELIABLE spectrophotometric data should now be more easily obtained with the aid of a new booklet, *Circular 484, Spectrophotometry* (200 to 1000 millimicrons) by Kasson S. Gibson, recently issued by the National Bureau of Standards.

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Metal Process Engineering

THERE was published early this year a most interesting book on the subject of Metal Process Engineering by Norman E. Woldman, a member of the faculty of the Cooper Union School of Engineering and of Stevens Institute of Technology Graduate School. The author states that the material for the book was accumulated gradually in the development of a postgraduate course in metallurgical engineering. In this volume the author has attempted to meet a growing demand for a short, yet thorough, treatise on various practical phases of metallurgical engineering and metallurgical processes. It was written to meet the needs of engineering students, professional engineers, and production men who would use the information in part or as a whole with their professional work.

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The book is published by the Reinhold Publishing Corp., 330 W. 42nd St., New York City, at a list price of $5.

Investigation of Purity of Aluminum-Silicon Die Casting Alloys

By Donald L. Colwell[1]

In 1934, the Society's Committee B-6 on Die-Cast Metals and Alloys initiated an investigation of the 5 per cent and 12 per cent silicon die-casting alloys and their normal impurities.[2] It was the opinion of some that perhaps the limitation of certain impurities to amounts much smaller than those allowed by the current specification would give properties superior to the properties of the specification.[3] Because these results are scattered through several volumes of the Society's *Proceedings* (and because the results of the test were the exact opposite of those expected), a summary of the significant conclusions at this time seems in order.

The Test

The test was made on three compositions: the high-purity grades of the 5 per cent silicon and the 12 per cent silicon alloys, and the regular grade of the 12 per cent silicon alloy. The latter was identified as No. V, and the other two as Nos. IVa and Va, respectively. Accelerated corrosion tests were made in $3\frac{1}{2}$ per cent salt spray and by immersion in $3\frac{1}{2}$ per cent salt solution. Normal corrosion tests were made by outdoor exposure at three locations: Sandy Hook, N. J., New York, N. Y., and Altoona, Pa.[2]

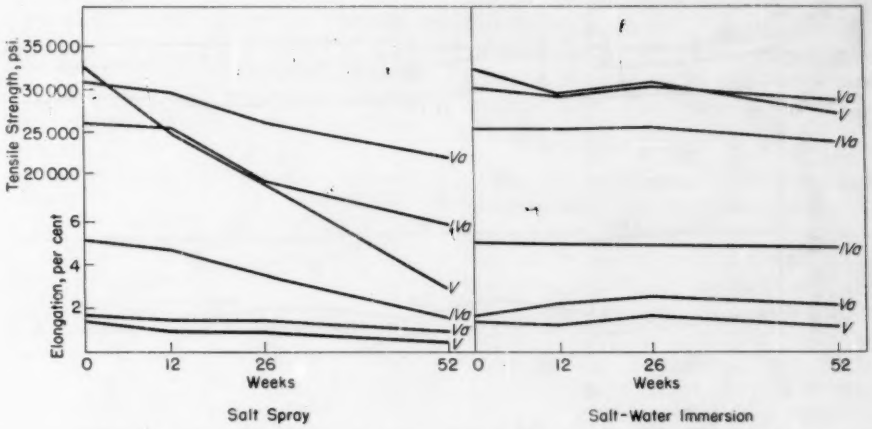

Fig. 1—Effect of Accelerated Corrosion on Tensile Strength and Elongation.

TABLE I.—COMPOSITIONS OF TEST BARS USED IN 10-YR. AND ACCELERATED EXPOSURE.[2, 3]

Code in 1934	Code in 1948	Code[a]	Composition, per cent[b]									
			Si	Fe	Cu	Mn	Mg	Zn	Ni	Sn	Pb	Others (Total)
IVa	S4 (special)	S5E (special)	4.75	1.08	0.10	0.015	0.01	0.00	0.01	0.00	0.00	...
Va	S5 (special)	S12A (special)	11.9	1.20	0.09	0.01	0.005	0.00	0.01	0.00	0.00	...
V	S5	S12A	12.14	1.44	0.42	0.26	0.055	0.52	0.32	0.05	0.025	...
A.S.T.M. Specifications B 85												
IV	S4	S5E	4.5–6.0	2.0	0.6	0.3	0.1	0.5[c]	0.5	0.1	...	0.2
V	S5	S12A	11.0–13.0	2.0	0.6	0.3	0.1	0.5[c]	0.5	0.1	...	0.2

[a] Alloys numbers according to new code proposed by Committee B 7.
[b] All values shown for Specifications B 85 are maximum except silicon; balance is aluminum.
[c] In 1933 zinc content was 0.75 per cent maximum.

TABLE II.—AVERAGE INITIAL MECHANICAL PROPERTIES (ROUND BARS ONLY).[2]

Note.—These values are weighted averages of round test-bar values given in Table V of 1935 report.[2] They are essentially the same as the initial values of Tables III and IV.

	Table Strength, psi.	Elongation, per cent
IVa	26 250	5.3
Va	30 525	1.8
V	32 190	1.7

TABLE III.—PROPERTIES AFTER SALT CORROSION TESTS.[2, 4]

Note.—Initial values are unweighted averages of round test bar values given in Table III of 1935 report.[2] Average Control values are unweighted averages of blank values given in Table VII of 1936 report.[4] Salt Spray values are calculated from the Average Control values by deducting the averages of percentage losses given in Tables VIII and IX of 1936 report.[4] Salt Water Immersion values are calculated from the Average Control values by deducting the averages of percentage losses given in Table X of 1936 report.[4]

	Initial	Average Control	Salt Spray			Salt Water Immersion		
			12 weeks	26 weeks	52 weeks	12 weeks	26 weeks	52 weeks
Tensile Strength, psi.								
IVa	26 360	27 170	25 300	19 600	15 700	25 800	25 900	24 900
Va	30 770	31 420	29 300	25 700	21 900	29 900	30 700	29 700
V	32 530	33 550	25 000	19 200	7 500	30 300	31 700	28 700
Elongation, per cent.								
IVa	5.4	5.35	4.6	3.4	1.9	5.3	5.2	5.2
Va	1.9	2.15	1.6	1.6	1.3	2.0	2.1	2.1
V	1.8	1.7	1.1	1.0	0.4	1.6	1.8	1.4

The test bars made included both the flat and the round test bar shapes. The flat shape has now become obsolete and the round test bar is the present A.S.T.M. standard. The corrosion and aging effects indicated no difference between the two shapes. The purpose of this paper is to compare compositions only so that other variables will be eliminated. The flat test bars, therefore, have been ignored, and strength and other data shown here are from the round bars only and are the averages of the bars from the two producers and from all laboratories concerned in a given exposure.

An inspection of the initial data led to the conclusion (among others) that, "The specimens of a given alloy, regardless of shape or producer, are of very uniform composition, especially as regards the minor impurities; indicating that contamination during casting was avoided."[2] The compositions shown in Table I, therefore, are typical, even though they are the averages of the round bars only from both producers. For comparative purposes, both the current and the 1934 specifications are shown in Table I. The alloy designations include the old and the current numbers and also the numbers under the new code which Committee B-7 has proposed. The initial average mechanical

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[1] Sales Engineer, Apex Smelting Co., Chicago, Ill.

[2] Appendix I, Report of Committee B-6, *Proceedings*, Am. Soc. Testing Mats., Vol. 35, Part I, p. 184 (1935).

[3] Tentative Specification for Aluminum-Base Alloy Die Castings (B 85 – 48 T), 1948 Supplement to Book of A.S.T.M. Standards, Part I-B, p. 251.

TABLE IV.—PROPERTIES AFTER OUTDOOR EXPOSURE[2, 6]

NOTE.—Initial values are unweighted averages of round test bar values given in Table III of 1935 report.[2] Average Control values are unweighted averages of blank values given in Table VI of 1946 report.[6] Five-year and ten-year values are calculated from the Average Control values by deducting the averages of percentage losses given in the second half of Table II of 1946 report.[6]

	Initial	Average Control	Sandy Hook		New York		Altoona		Average	
			5 yr.	10 yr.	5 yr	10 yr.	5 yr.	10 yr.	5 yr.	10 yr.
TENSILE STRENGTH, PSI.										
IVa	26 360	27 090	26 700	26 304	26 500	25 700	26 200	25 500	26 400	25 800
Va	30 770	31 320	30 500	29 600	29 300	29 100	29 900	29 200	29 900	29 300
V	32 530	33 330	31 200	31 800	31 900	31 700	32 100	31 600	31 700	31 700
ELONGATION, PER CENT										
IVa	5.4	5.4	5.4	5.2	5.3	4.3	5.3	4.9	5.3	4.8
Va	1.9	2.0	2.2	1.7	1.8	1.6	2.0	1.7	2.0	1.7
V	1.8	1.7	1.7	0.9	1.4	1.4	1.7	1.6	1.6	1.3

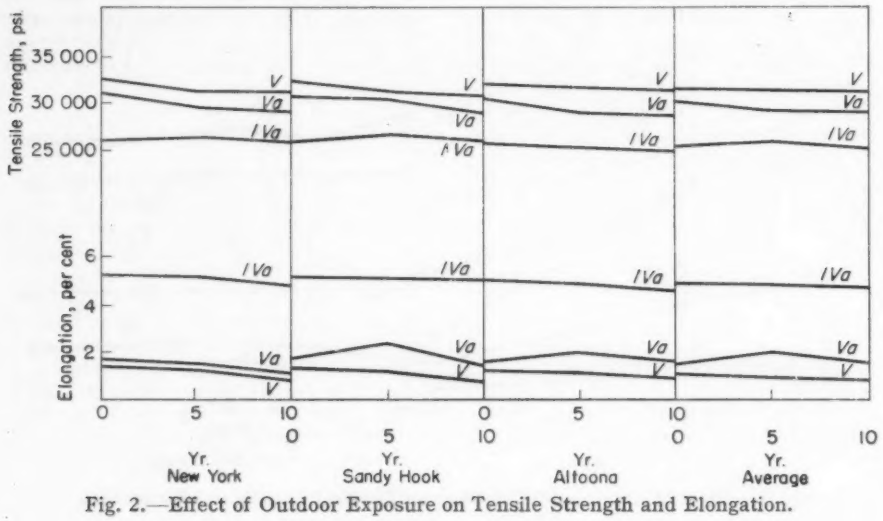

Fig. 2.—Effect of Outdoor Exposure on Tensile Strength and Elongation.

TABLE V.—CORROSION ATTACK ON FLAT TEST BARS.

NOTE.—Averages of values shown in Table V of the 1946 report.[6]

	Sandy Hook		New York		Altoona		Average	
	5 yr.	10 yr.	5 yr.	10 yr.	5 yr.	10 yr.	5 yr.	10 yr.
AVERAGE DEPTH OF ATTACK, MILS								
IVa	3.5	3.4	3.5	4.7	4.9	5.8	3.97	4.63
Va	4.2	4.35	3.5	4.95	4.65	4.4	4.12	4.57
V	4.05	4.65	4.35	4.95	4.5	5.3	4.3	4.97
MAXIMUM DEPTH OF ATTACK, MILS								
IVa	5.45	4.85	4.35	7.95	6.7	8.4	5.5	7.07
Va	5.75	7.7	4.65	7.95	6.6	7.0	5.67	7.55
V	5.9	5.85	5.45	7.8	6.45	7.2	5.93	6.95

TABLE VI.—AVERAGE CHEMICAL COMPOSITIONS OF SG2 ALLOY TEST BARS.[7]

Code in 1948	Code Proposed[a]	Composition, per cent							
		Si	Fe	Cu	Mn	Mg	Zn	Ni	Sn
SG2	SG 100A	9.72	1.11	0.20	0.01	0.54	0.06	0.01	0.02
SG2 (Special)	SG 100A (Special)	9.61	0.30	0.04	0.005	0.54	0	0.01	0.02

[a] Alloy numbers according to new code proposed by Committee B 7.

properties are shown in Table II. As would be expected, the higher purity alloy Va has a lower strength and a slightly higher elongation than alloy V.

It should be pointed out that at the time the test was begun only gooseneck machines were available; consequently, all bars were made on gooseneck machines and all tests and all specifications discussed are based on gooseneck practice.

ACCELERATED CORROSION TESTS

Accelerated corrosion in $3\frac{1}{2}$ per cent salt spray was made both by the Aluminum Research Laboratories and by the Bell Telephone Laboratories.[4] The former proved much more severe than the latter, but for the comparison of alloys made in this discussion the two are averaged together. Salt spray tests are at best only comparative, and as the averages show a severe loss of strength for all three alloys, the test is a measure only of salt spray corrosion. None of the three alloys proved satisfactory in this test, although the deterioration of No. V was more rapid than that of the other two. This difference was not confirmed in the outdoor exposure test, even on the seacoast.

Accelerated corrosion in $3\frac{1}{2}$ per cent salt solution by alternate outdoor immersion was made by the Aluminum Research Laboratories.[4] In this accelerated test the three alloys behaved substantially alike, and the maintenance of strength and elongation of the high-purity alloys IVa and Va was no better than that of the commercial alloy V. Stated another way, the resistance to alternate immersion in $3\frac{1}{2}$ per cent salt solution was not affected by the appreciable amounts of copper, manganese, zinc, and nickel contained in alloy No. V. Could it be that the harmful effects of copper and nickel on the corrosion resistance of aluminum are neutralized by the beneficial effects of manganese and zinc?

The alloy comparison in these two accelerated corrosion tests is shown in Table III and visually demonstrated in Fig. 1. In each case the percentage changes were averaged to eliminate all variables but alloy, and the strengths and elongations were calculated from the general average control values given in the committee report. It is clearly evident from Fig. 1 that the salt spray test weakened all alloys, No. V the most; and that the salt water immersion test had no significant effect on any of the three.

OUTDOOR EXPOSURE

The tension test specimens were exposed at three outdoor locations, Sandy Hook, N. J., New York, N. Y., and Altoona, Pa., for five and ten years. The round bars were then tested for tensile strength and elongation along with a similar set of bars which had been stored

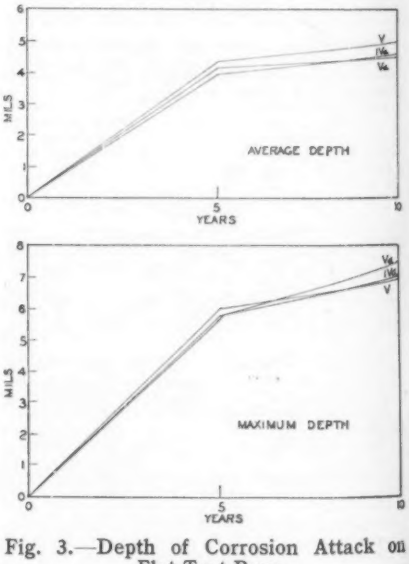

Fig. 3.—Depth of Corrosion Attack on Flat Test Bars.

[4] Appendix I, annual report of Committee B-6, *Proceedings*, Am. Soc. Testing Mats., Vol. 36, Part I, p. 182 (1936).

indoors for the same period. Losses in mechanical properties were calculated to percentages of control strengths lost in five years[5] and ten years.[6] A careful comparison of the three alloys, however, is difficult because of this method of presentation. Furthermore, the losses after ten years are computed both from the ten-year-old control bars and from the averages of all control bars tested over the ten-year period,[6] complicating a quick survey of the results of the test.

In this discussion, the percentage changes given in the reports have been applied to the average control figures. The resulting tensile strengths and elongations have been averaged for all round bars tested at both laboratories for each test location. The results are shown in Table IV and in the first three charts in Fig. 2. The variations in location have been further eliminated by averaging the three location results and plotting in the right-hand chart in Fig. 2. This gives a direct comparison of the three alloys in their resistance to atmospheric corrosion. A glance at Fig. 2, particularly at the average right-hand chart, is sufficient to show that in resistance to atmospheric corrosion here the low-purity alloy V is at least as good as the two alloys of higher purity. Stated another way, the higher amounts of copper, manganese, zinc, and nickel shown in Table I have not impaired the resistance to atmospheric corrosion of these silicon alloys. Could it be again that the harmful effects of copper and nickel on the corrosion resistance of aluminum are neutralized by the beneficial effects of manganese and zinc?

One more comparison of the corrosive effects of the three atmospheric locations was made by a microscopic measurement of depth of attack made on transverse sections of the flat test bars.[6] Both average and maximum depths of pitting were measured as indicated in Table V. The three locations were alike in the amount of attack, so all three were averaged and the resulting averages for both the average depth and the maximum depth are plotted in Fig. 3. Even a casual glance at Fig. 3 shows that the depth of attack, whether average or maximum, was almost exactly the same for all three alloys. Once more, therefore, it is evident that in these exposures the higher amounts of copper, manganese, zinc, and nickel have not affected the corrosion resistance of this silicon aluminum alloy.

Committee Conclusions

In its several reports from 1935 to 1946, Committee B-6 has published a number of conclusions based on these tests. It is appropriate here to select those conclusions bearing on the relationships of the three alloys and to group them in one place. The numbers are the numbers of the conclusion in the particular report.

"3. The average tensile strength of alloys Nos. IVa and Va, as supplied by a number of producers, will probably be about 5 to 10 per cent less than that of their lower-purity counterparts but the elongations will be slightly higher."[2]

"1. The resistance of alloy No. Va to salt spray corrosion, as indicated by losses in tensile strength, is superior to that of either alloy No. IVa or No. V."[4]

Comment.—None of the three alloys resisted salt spray corrosion. The comparison is graphically shown in Fig. 1, left chart. If all are poor, the test is not selective enough, and it seems unfair to condemn one sample as worse than another.

"4. The reductions in tensile strength caused by exposures to the outdoor alternate-immersion test for up to 52 weeks were generally within the limits of experimental error but do indicate a lower resistance to corrosion for alloy No. V than for alloys Nos. IVa and Va."[4]

Comment.—This statement seems unfair to alloy V. If variations were within the limits of experimental error no trend should be mentioned. The comparison in Fig. 1, right chart, certainly shows no significant difference between the resistances of the three.

"5. After exposures in the Bell Telephone Laboratories' salt spray tank or in the alternate-immersion apparatus, the strength of alloy No. V is approximately as high as the strength of alloy Va, even though the percentage loss, as compared to the original strength, is greater."[4]

"The results of the tests and examinations of specimens exposed for five years at Sandy Hook, New York, and Altoona indicate that alloys Nos. IVa, Va, and V all have a sufficiently high resistance to corrosion that none suffer, in this time, a significant change in mechanical properties. It is therefore not possible to establish any order of merit for the several materials."[5]

"The results of the tests and examination of specimens exposed for ten years at Sandy Hook, New York, and Altoona show that alloys IVa, Va, and V all exhibit a high resistance to corrosion. These exposures caused, on the average, small but significant losses in the strength of the three alloys, but there were no really significant differences among the three alloys. . . ."[6]

"It is noteworthy from a comparison of the 5- and 10-year data—that the corrosion of the specimens is occurring at a definitely decelerating rate. Consequently, it is likely that the losses in mechanical properties of the specimens will be of a small order of magnitude even after a considerably longer period of exposure, and that no really marked differences are to be expected among the three alloys under study."[6]

Later Tests

Subcommittee I of Committee B-6 has under way another test comparing the commercial and high-purity grades of an aluminum alloy containing 9.5 per cent silicon and 0.5 per cent magnesium.[7] This test is not complete, but so far the indications are that the results will be similar to those of the early test. A 20 per cent salt spray at 95 F. for 52 weeks is harmful to both grades, and outdoor exposure at New York and at Sandy Hook for two years has affected neither one appreciably.[7] The compositions tested are shown in Table VI.[7]

In the experience of the author, there have been many indications of the beneficial effects of manganese and zinc on the corrosion resistance of aluminum. Walton has presented some data as yet unpublished[8] which may throw some further light on the subject and in which the effect of zinc up to 1¼ per cent seems helpful rather than harmful.

Effect of Purity of Alloy

The above discussion is not presented as proof that aluminum-base alloys are not affected by impurities. Comparisons are made only within the limits of the published A.S.T.M. data and are made only by plain arithmetical averages. The similarity of the performances of the commercial and high-purity grades of these alloys is so pronounced, however, that it is believed one should not be considered superior to the other unless positive proof is available. The 1934 test was begun with the belief that for some reason the high-purity alloys would prove superior to standard alloys as specified by the A.S.T.M. The results not only fail to bear out this belief, but give strong support to a belief that in so far as exposure conditions likely to be encountered are concerned, the commercial grades are the equal of the high purity grades.

When there is a shortage of essential materials such as occurred during the war, it is imperative that no unnecessary specification requirements interfere with the availability of materials. Impurity limits for any material that are too narrow seriously reduce the amounts of that material available; therefore, such impurity limits should be as wide as service requirements will permit. In the case of these aluminum die-casting alloys, all the evidence to date is in favor of the impurity limits now included in A.S.T.M. specifications and against unnecessarily high-purity requirements. It should not be necessary for a War Production Board to have to change such limits after an emergency is upon us. Specifications should be drawn up now so as to take every advantage of all satisfactory available material.

[5] Appendix I, annual report of Committee B-6, *Proceedings*, Am. Soc. Testing Mats., Vol. 40, p. 191 (1940).

[6] Report of Subcommittee I on Aluminum-Base Die-Casting Alloys, Committee B-6, Proceedings, Am. Soc. Testing Mats., Vol. 46, p. 225 (1946).

[7] Appendix, report of Committee B-6, *Proceedings*, Am. Soc. Testing Mats., Vol. 48, p. 191 (1948).

[8] C. J. Walton, "Resistance to Corrosion and Stability of Some Aluminum Die-Casting Alloys," presented before Am. Die Casting Inst. September 22, 1949.

Modern Microscopy of Films and Fibers[1]

By F. F. Morehead[2]

THE present-day microscopist is confronted with an appalling array of devices for obtaining an enlarged view of a sample. To attain this end, not only are advances in instrumentation available but also the many methods of sample preparation aid in arriving at the true interpretation of appearances. The whole field of microscopy has been greatly stimulated by the advent of the electron microscope which has extended by the factor of nearly 200 the limits of resolution imposed on the light microscope by the nature of light itself. Fortunately there is a region in magnification where the two systems overlap so that the electron microscope extends the knowledge gained from observation with the light microscope.

The availability of high magnification sometimes constitutes a decided pitfall, and one may expand the expression of "Not seeing the forest for the trees" to include the bark of a single twig of the tree or even the very cracks in the bark of that twig.

The four micrographs shown in Figs. 1, 2, 3, and 4, studies of a crepe fabric,

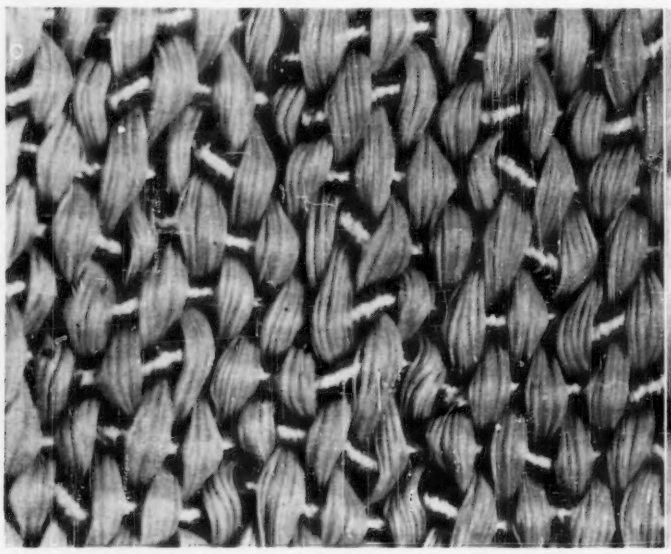

Fig. 1.—Crepe Fabric (×10) Taken with BeL 32 mm. Micro Tessar.

Fig. 2.—Crepe Fabric (×100) Taken with Leitz Ultrapak.

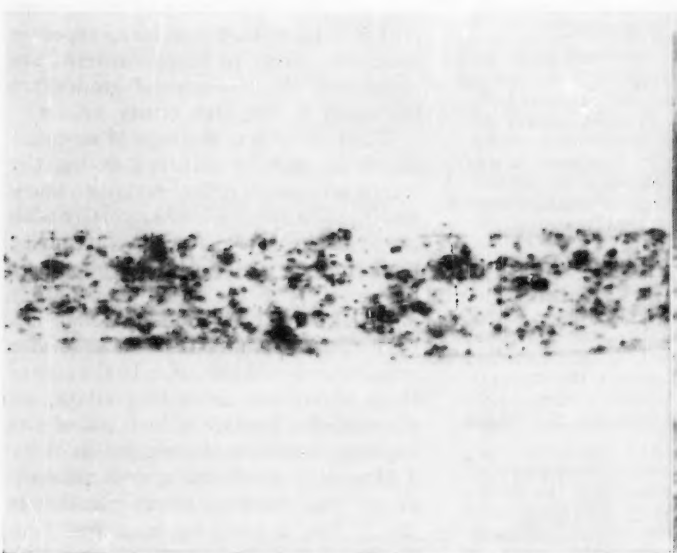

Fig. 3.—Single Fiber from Crepe Fabric (×1000) Taken with B-Phase Plate.

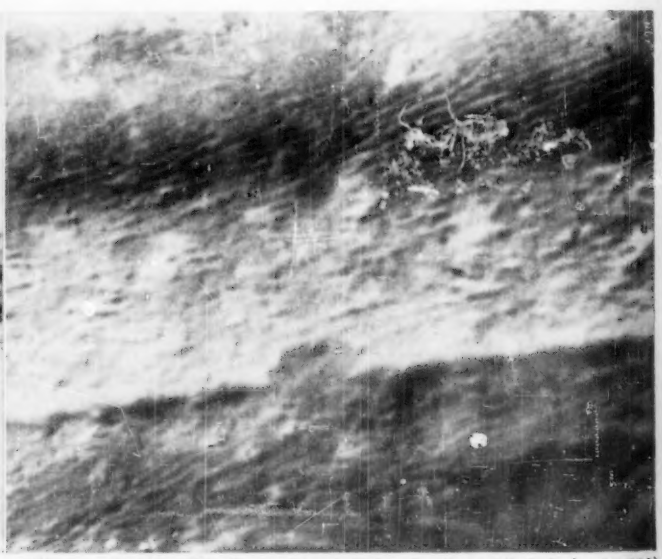

Fig. 4.—Surface Replica of Single Fiber for Crepe Fabric (×10,000) Electron Micrograph.

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[1] Excerpts of a paper presented at a meeting of A.S.T.M. Committee D-13 on Textile Materials held in Philadelphia, Pa., October 20, 1949.

[2] American Viscose Corp., Marcus Hook, Pa.

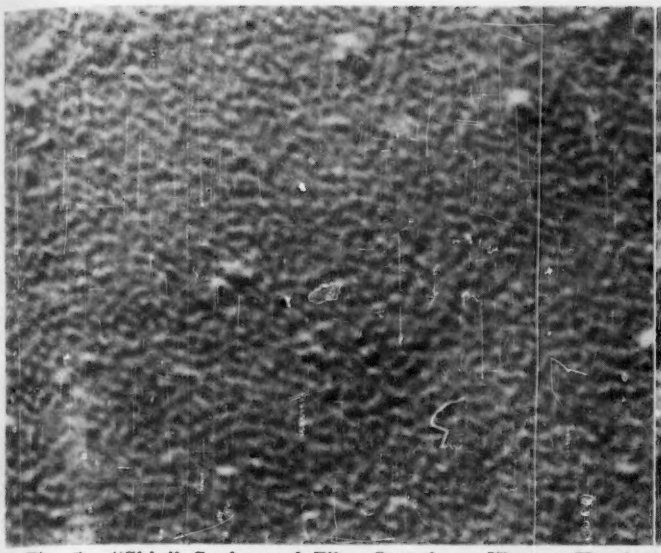

Fig. 5.—"Skin" Surface of Film Cast from Viscose Uranium Shadowed (×100,000).

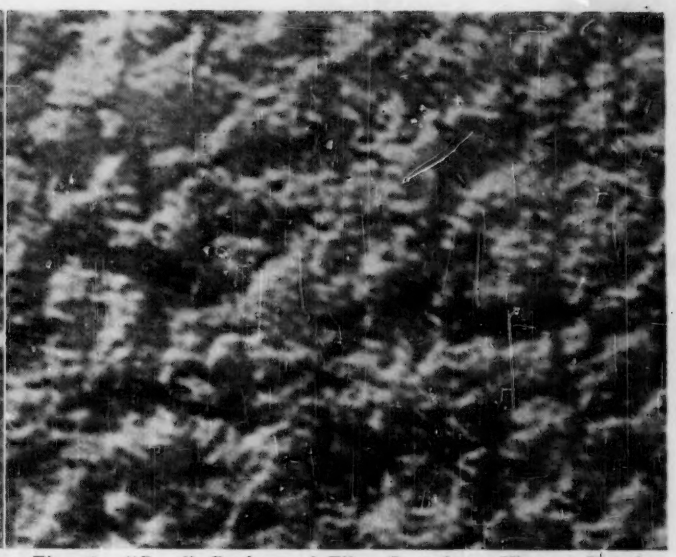

Fig. 6.—"Core" Surface of Film Cast from Viscose Uranium Shadowed (×100,000).

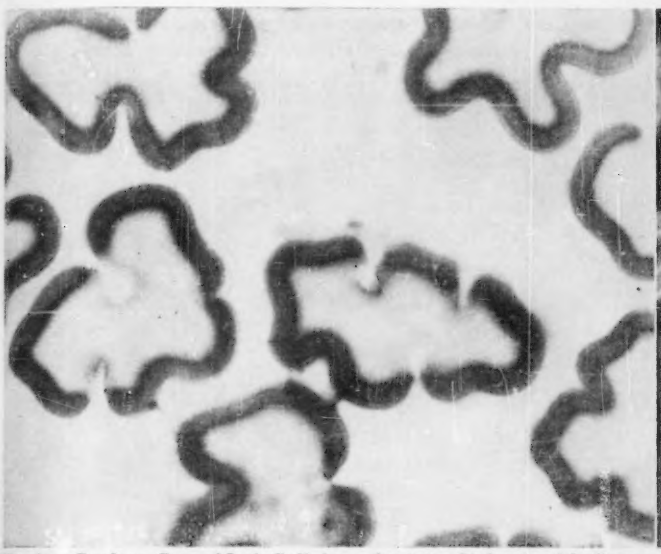

Fig. 7.—Surface Saponified Cellulose Acetate Stained with Congo Red Cellulose (dark) $n = 1.54$, Cellulose Acetate (unstained) $n = 1.47$.

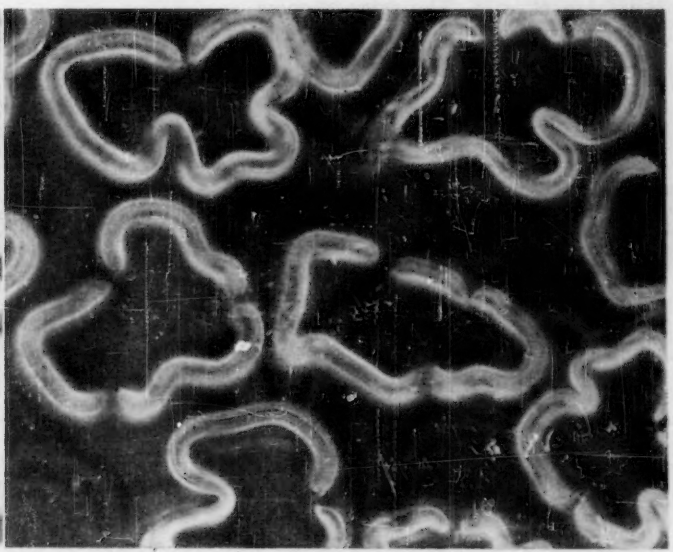

Fig. 8.—Same Sample as Fig. 7 (unstained) "Dark Contrast—High" Phase Plate. Mounting Media $n = 1.48$.

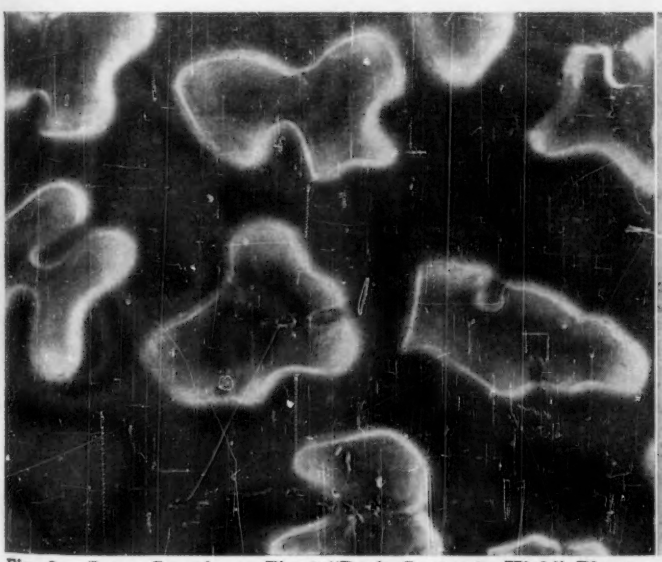

Fig. 9.—Same Sample as Fig. 8 "Dark Contrast—High" Phase Plate. Mounting Media $n = 1.52$.

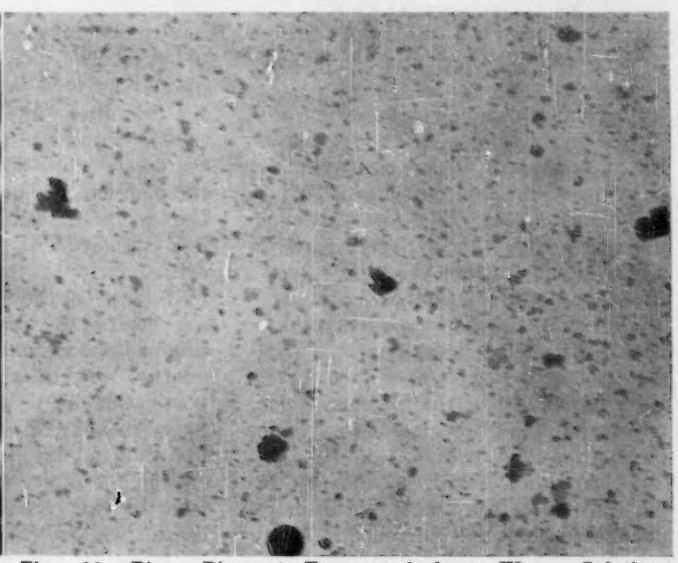

Fig. 10.—Blue Pigment Evaporated from Water Solution (×20,000).

Note presence of round polystyrene latex particle whose diameter averages 2590 A in this and following electron micrographs.

taken at different magnifications, 10,100, 1000, and 10,000, illustrate this point. Since the original object of the investigation was to observe the effect of twist on the creping action of the yarn, the picture at 10 magnifications tells the story.

This series illustrates that most of the information obtained from the longitudinal view of the fiber is largely confined to the surface characteristics and points to the need for obtaining the shape of the fiber at 90 deg. to its axis, that is, the cross-section.

Cross-sections of fibers may frequently be stained to reveal further structural differences, as, for example, the "skin effect" (3, 6)[3] in viscose rayon. Many of the manufacturing variables of the viscose process affect not only the shape of the cross-section but also influence the thickness and evenness of the "skin effect." The same staining technique when applied to films cast

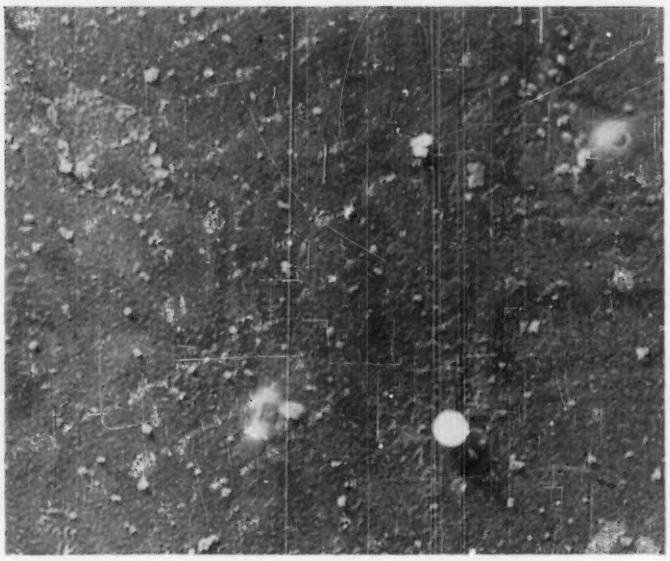

Fig. 11.—Same as Fig. 10. Uranium Shadowed (×20,000).

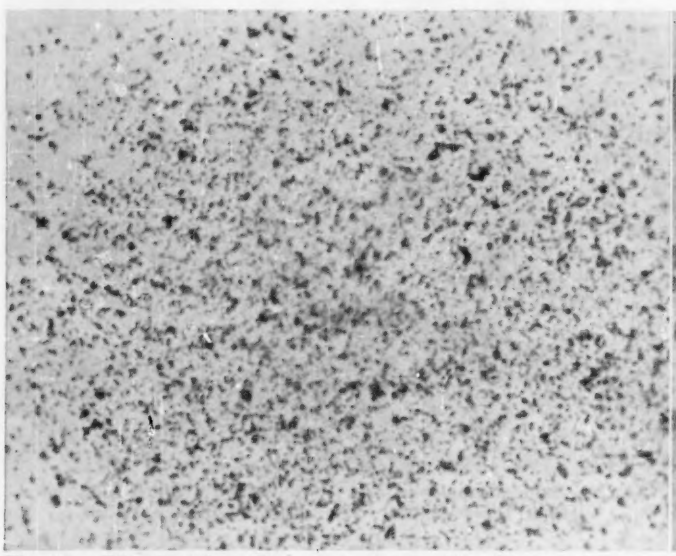

Fig. 12.—Film Cast from Viscose Containing Blue Pigment Taken with "B Minus Contrast—Medium" Phase Plate (×1000).

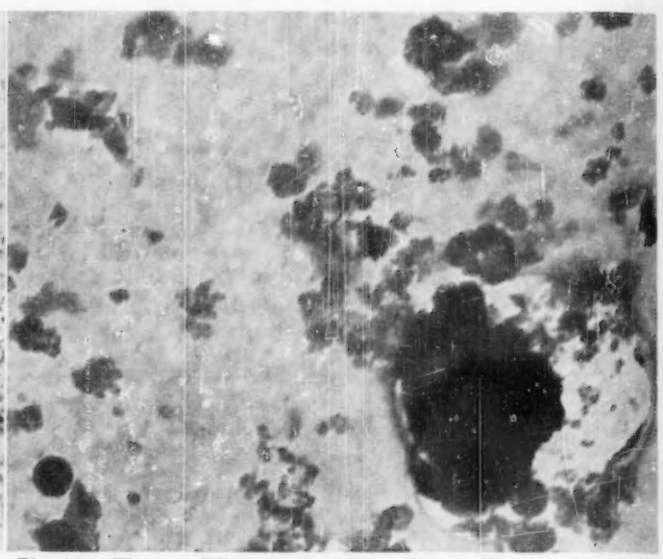

Fig. 13.—Electron Micrograph of Same Film as Fig. 12 (×20,000).

from viscose solutions by spreading the viscose on a sheet of glass and regenerating in a standard viscose yarn spinning bath reveal that the film has a "skin" and "core" (2, 4). The fact that such films are cast without any orienting or stretching shows that the "skin effect" is not due to orientation.

The "skin effect" of viscose rayon has been defined in a joint paper by Mr. Sisson and the author (6) "as that outer layer or portion of the filament which retains its blue color after it is dyed in an aqueous solution of Victoria Blue 'B' and cleared in a 90 per cent dioxane, 10 per cent water solution." It was also postulated that the difference between the "skin" and the "core" was that of *crystal size* which had its origin in the temporary cross link formed between the zinc ions in the spinning bath and the cellulose xanthate. These cross links permitted the formation of many crystal nuclei but limited crystal growth by preventing the rotation of the cellulose chains, thus inhibiting the formation of large crystals. Figures 5 and 6 offer a very interesting proof of the postulation as it shows the two surfaces, "skin" and "core" of a very thin film which has been prepared thin enough for direct viewing in the electron microscope as described in greater detail elsewhere (5). Uranium shadowing reveals the difference in the two surfaces. As most of the water on the wet film was present in the "amorphous" or noncrystalline areas, these have shrunk on drying, leaving the crystallites as "hills" and the amorphous areas as "valleys" in the dry film.

The actual measurements of the "skin" and "core" particles are given in Table I.

TABLE I.—LENGTH OF "SKIN" AND "CORE" PARTICLES.

	Particle Length Å		
	Max.	Min.	Avg.
Top or "Skin" surface of film	150	75	104
Bottom or "Core" surface of film	250	125	206

The Phase Microscope

The design of the phase microscope is really based on the concept that *the specimen and its surroundings are part of the optical system* of the microscope

[3] The boldface numbers in parentheses refer to the list of references appended to this paper.

(1, 7). This means that the phase microscope is a means for detecting slight differences in optical path in different parts of the specimen. Since the optical path is thickness times the index of refraction, the necessity for the use of very thin specimens is obvious.

An excellent fiber for examination in the phase microscope is surface saponified cellulose acetate, since portions of the cross-section possess different indices of refraction, the saponified portion being cellulose ($n = 1.54$) and the cellulose acetate ($n = 1.47$). Figure 7 shows such a yarn stained with Congo Red and photographed to show the red-stained portions (cellulose) dark, the cellulose acetate being unstained. Figures 8 and 9 show that either the cellulose or cellulose acetate may be rendered bright by the proper choice of phase plate and mounting media.

The application of both light and electron microscopy to the examination of a pigment designed for viscose spin dyeing, that is, the incorporation of the dye in the viscose solution before spinning, is illustrated in the following: Figure 10 is a direct transmission electron micrograph of the dye evaporated from a water solution. Figure 11 is the same preparation metal shadowed which reveals the pigment to be thin plates rather than equidimensional particles. Figure 12 is a "B minus contrast-medium" phase photomicrograph of a very thin film of cellulose cast from a viscose solution containing the dye. The pigment particles are much larger than could be expected from the electron micrographs. Figure 13 is an electron micrograph of the same film which corroborates the above by revealing the particles are aggregates and the problem is that of more adequate dispersion rather than particle size.

As a final challenge, it is to be pointed out that the field of light microscopy has been developing for nearly 350 yr. and is still growing while the commercially available electron microscope has been in use for barely more than 10 yr. There still exists in both fields the opportunity for the exercise of imagination and ingenuity in finding new uses and applications for both instruments.

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A New Technique for Cutting Very Thin Sections and Its Application to the Electron Microscopy of Fibers*

By Sanford B. Newman[1]

In commercial electron microscopes employing accelerating potentials of 50 kv., the specimen thickness must be held to a few tenths of a micron due to the limited penetrating power of the electron beam. The application of the electron microscope to many biological and industrial problems has been hampered by lack of an efficient and inexpensive method for producing these thin specimen sections. Wedge-shaped sections (1, 2)[2] and the high-speed microtome (3, 4) have been utilized with some success but neither of these lend themselves to routine procedures and the expense of the microtome is a serious drawback. More recently, Pease and Baker (5) have made an important contribution to the technique of thin sectioning by adapting a conventional microtome for use in ultramicrotomy.

However, the available techniques leave much to be desired, especially in working with tough oriented materials, and it was necessary to develop an improved method for obtaining the large numbers of fiber sections required for study.

In most of the early work in microsectioning, the classical materials (for example, collodion and paraffin) had been used for surrounding the specimen and holding it in place while it was being cut. Experience with polybutyl methacrylate as an embedding medium in leather microscopy had revealed the excellent cutting quality of this water-clear resin. A copolymer of 80 per cent polybutyl methacrylate and 20 per cent polymethyl methacrylate gave the best results with most fibers.

The one disadvantage of the resin, as an embedding medium, lies in the violence of the polymerization reaction which can result in damage to delicate tissues. With most commercial fibers, however, this is not a serious consideration since they can undergo more rigorous treatment without suffering degradation.

In addition to the new embedding medium, a device of radical design for feeding the specimen to the knife was contrived and used. This device utilizes the thermal expansion of a brass block for advancing the embedded material to the cutting edge. Details of the device are shown in Fig. 1 and an assembled and operating view appears in Fig. 2. As shown in Fig. 1, the brass block, *a*, is drilled through its main axis and one end of the hole is tapped to receive the $\frac{3}{8}$-in. brass pipe plug, *b*. The pipe plug has a hole in its outer face to provide a snug fit for the specimen, *c*. A needle valve, *d*, *e*, is inserted in the side of the block. The specimen, *c*, is held in the brass plug by a film of rubber-paraffin mixture.

The assembled device is clamped in the jaws of a laboratory microtome, and compressed carbon dioxide is admitted into the hollow block and allowed to expand. The expansion of the gas

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[2] The boldface numbers in parentheses refer to the list of references appended to this paper.

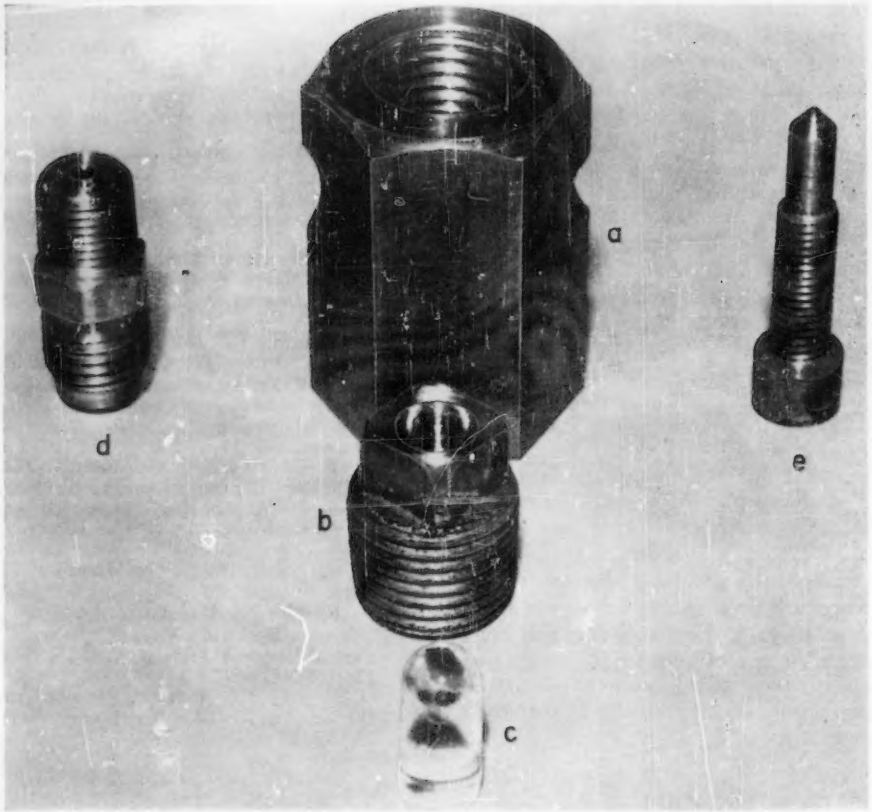

Fig. 1.—Details of the Thermal Expansion Microtome Device.

a, brass block; *b*, pipe plug; *c*, embedded specimen; *d*, *e*, needle valve.

lowers the temperature of the block causing it to contract. When sufficient contraction has occurred, the gas flow is stopped. The knife and specimen are then adjusted to the cutting position and the mechanical advancing mechanism is disengaged. As the block warms, it expands, carrying the specimen forward. The specimen is being stroked past the knife-edge by the vertical motion of the microtome at the same time. The thickness of the resulting sections, of the order of a few tenths of a micron, may be controlled to some extent by the time interval between strokes. Once the sections are cut they are flattened by placing them on a dioxan-water mixture as recommended by Pease and Baker (6). After this they are processed in the usual way. Due to the poor properties of the methacrylates in the electron beam, the matrix must be removed during the mounting procedure by dissolving it in toluene.

Probably in all thin sectioning techniques, proper knife sharpness is a key factor. The knives used in sectioning fibers were first ground and polished on a Fanz type automatic sharpener. Subsequently, the edges were finished first on a tension strop and then on a backed strop. Both of the strops were charged with diamond dust of fairly small particle size, 0.0 to 0.5 μ. Fibrous materials caused rapid deterioration of the cutting edge as compared to the effect of soft biological tissues.

Cuprammonium, viscose, and regenerated acetate filaments were embedded and sectioned by the techniques described and studied in the electron microscope. From a study of several hundred preparations, it was concluded that the spongy, perforate structure of viscose shown in Figs. 3 and 4 is an artifact caused by electron bombardment. By judicious use of the beam, however, the amount of damage can be held to a minimum or eliminated entirely. The electron micrograph in Fig. 5 is a typical undamaged cross-section. Skin and core can be clearly differentiated, but the wealth of pores and holes demonstrated by Horio (7) is lacking.

Cotton sections are about equally sensitive to artifact formation and must also be exposed carefully in the microscope. Sections of raw cotton examined thus far have failed to reveal the complex structure which has become so familiar through work with swelling techniques. Figure 6 is part of a cross-section of raw cotton. Hints of fibrillar windings may be detected, but these are so faint that they do not lend themselves readily to photographic recording.

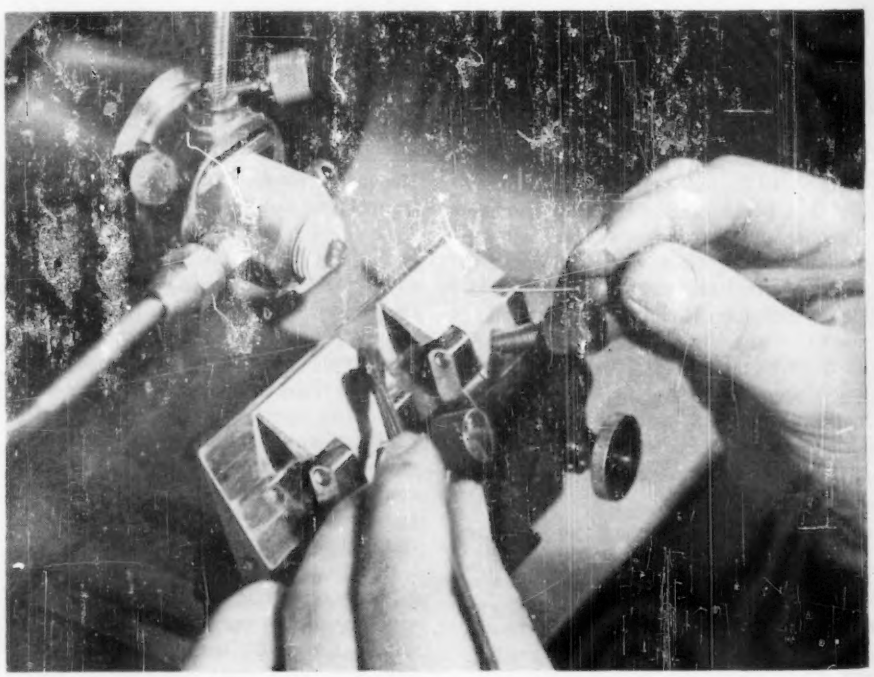

Fig. 2.—Assembled and Operating View of the Thermal Expansion Microtome Device.

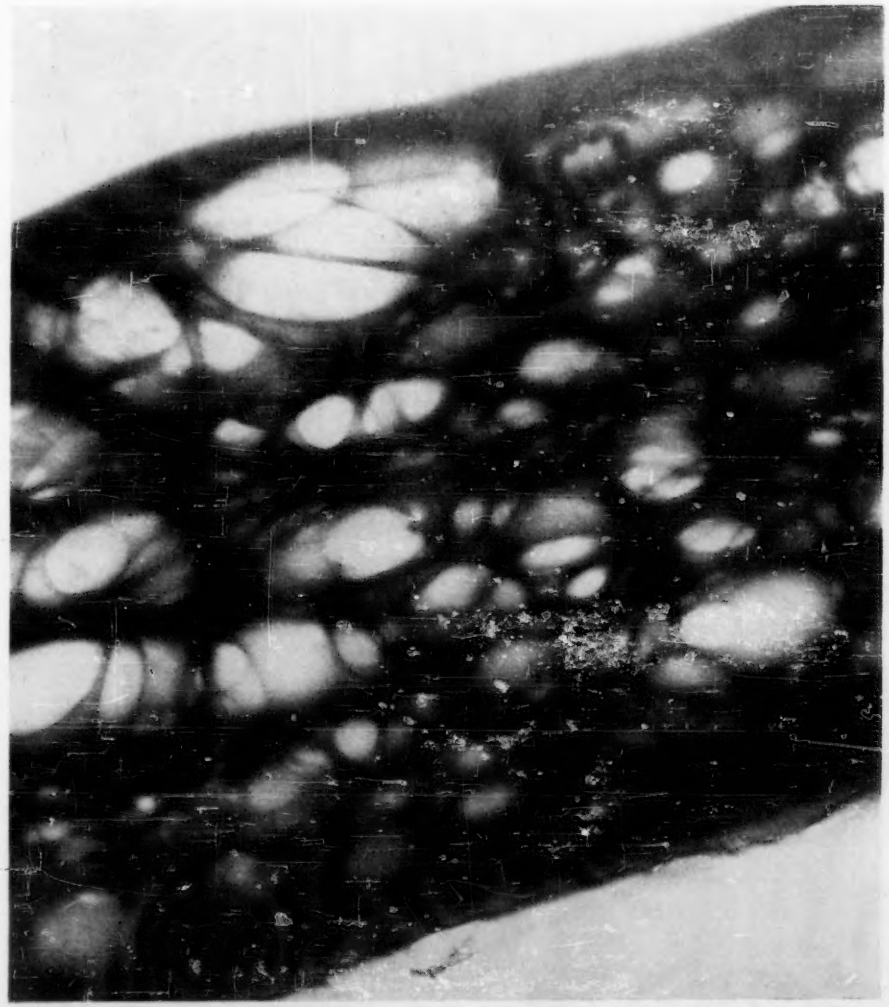

Fig. 3.—Longitudinal Section of Deacetylated Acetate Showing Severe Damage Due to Electron Bombardment.

Electron micrograph, total magnification ≈ × 21,000 (el. × 7000, opt. × 3).

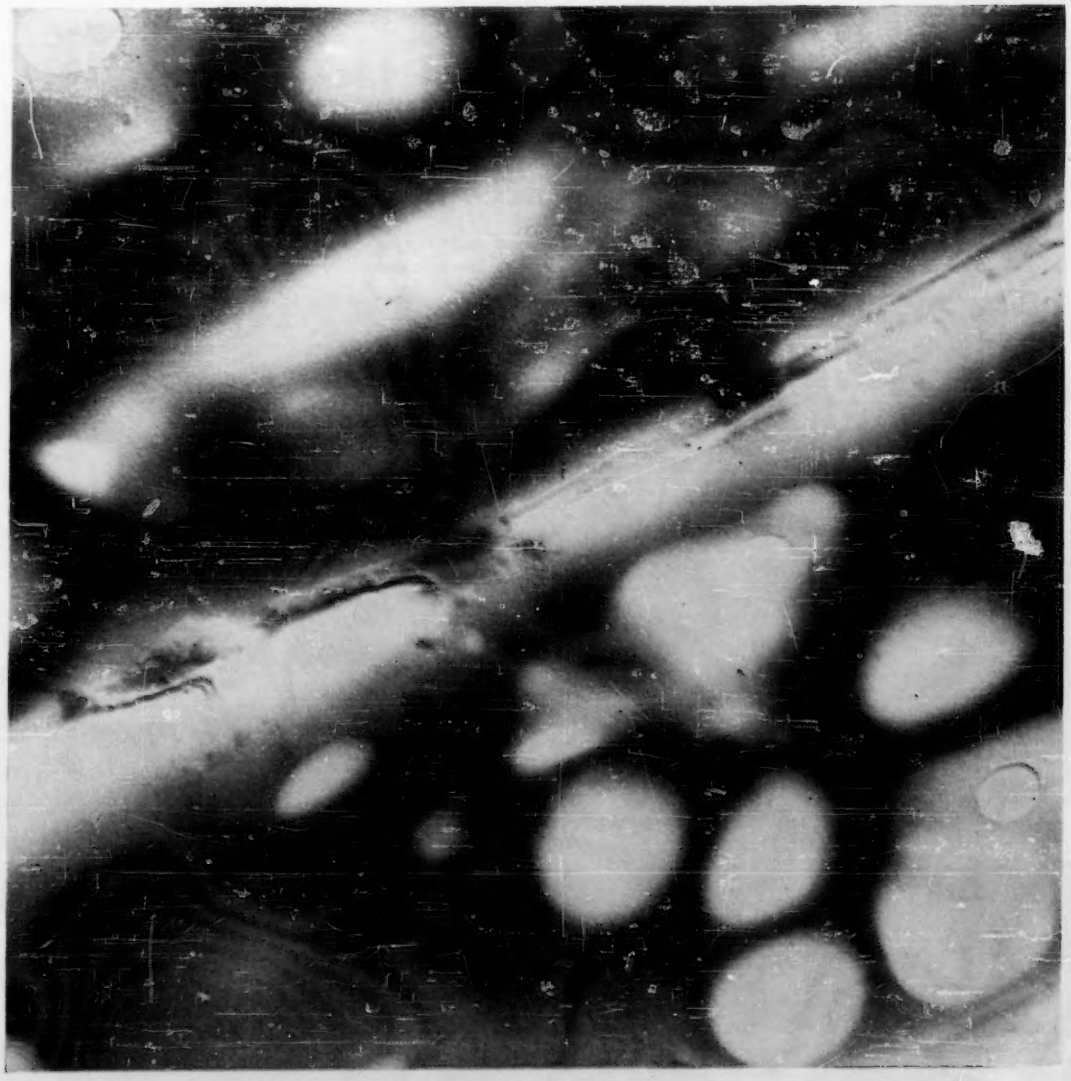

Fig. 4.—Longitudinal Section of Deacetylated Acetate Showing Moderate Damage Due to Electron Bombardment.

Electron micrograph, total magnification ≈ × 21,000 (el. × 7000, opt. × 3).

Fig. 5.—Cross-Section of a Fiber of Cuprammonium Rayon.
Electron micrograph, total magnification ≈ × 21,000 (el. × 7000, opt. × 3)

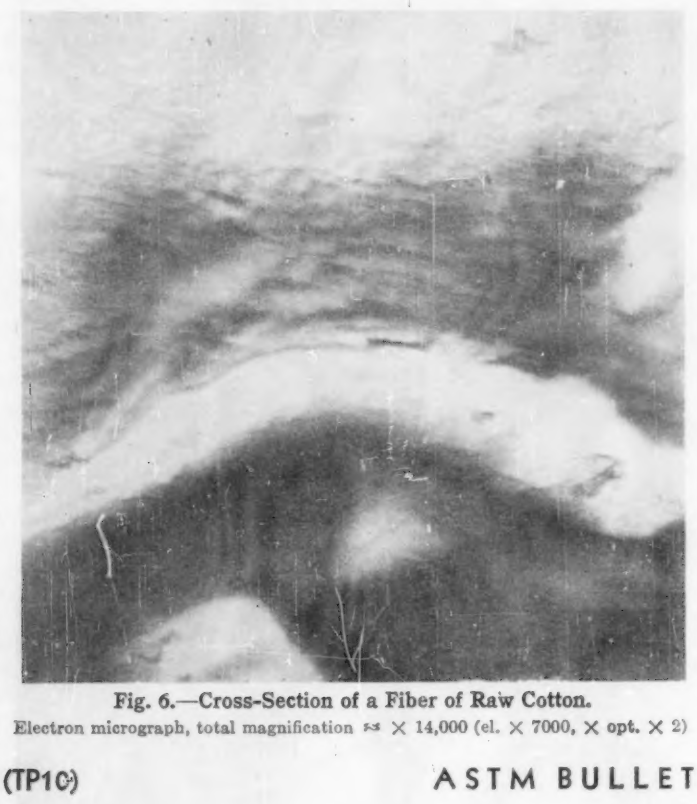

Fig. 6.—Cross-Section of a Fiber of Raw Cotton.
Electron micrograph, total magnification ≈ × 14,000 (el. × 7000, × opt. × 2)

Further work with this material must include some investigation of the use of electron staining or other differentiating technique. Phosphotungstic acid and silver precipitation methods have been applied but, thus far, without success.

Longitudinal sections of wool have been found useful for giving a direct measure of the amount of overlap of scales. In a single cross-section of wool the concentric rings reported in human hair (6) were clearly seen. However, many others failed to show the structure.

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Tests for Air-Entraining Agents in Cement and Concrete

By G. W. Washa,[1] C. H. Scholer,[2] D. W. Lewis,[3] and N. H. Withey[4]

SYNOPSIS

An extensive program of tests, planned with the help and guidance of the Working Committee on Additions of A.S.T.M. Committee C-1 on Cement, has had as its primary objective A.S.T.M. acceptance of N-Tair for use in the manufacture of air-entraining cement. Cements ground with and without this agent in commercial mills were donated by six different cement companies. Tests on concretes and mortars made at three laboratories showed that N-Tair compared favorably with Vinsol Resin and Darex in producing the desired improvements in freezing and thawing resistance, placeability, plasticity, and homogeneity of the concrete. Also the agent did not adversely affect setting time, rate of strength gain, volume change, or sulfate resistance.

This paper adds considerable data to the literature that has already been published showing the advantages to be gained by controlled air entrainment, and also adds some interesting and valuable information on technique of testing and interpretation of results of freezing-and-thawing tests.

IT IS well known that there are a large number of fatty acids, detergents, fats and oils, fatty alcohols, resins, resinates, etc., that will cause air entrainment in concrete. However, as a protection to the producers and users of air-entraining cement, A.S.T.M. Committee C-1 has required that if an agent is to be included in the A.S.T.M. specifications as an acceptable addition in the manufacture of cement, it must be subjected to a comprehensive test program to insure that the agent will produce the desired and expected improvement in certain properties of concrete without adversely affecting others. It has been well established that entrainment of a controlled amount of air should bring about a marked improvement in the resistance of concrete to freezing and thawing and should also improve plasticity, placeability, and homogeneity of the concrete. It is also well known that the strength of concrete is usually reduced as the amount of entrained air is increased unless a sufficiently large reduction in the water-cement ratio is secured by redesigning the mix. For a given consistency some reduction in the water-cement ratio is brought about by the entrainment of air, especially in the leaner mixes. But for equal workability a reduction in the percentage of sand is permitted with air entrainment which will still further reduce the water-cement ratio and further offset the reduction in strength due to the presence of air.

The agent must not adversely affect the setting time, volume change, or resistance to sulfate solutions; the agent itself (not the air entrained by the agent) must not adversely affect the strength.

PURPOSE

At the time these tests were undertaken, two air-entraining agents known as Vinsol resin and Darex were permitted for use in the manufacture of air-entraining cement by A.S.T.M. Tentative Specifications for Air Entraining Portland Cement (C 175–48 T) and Portland Blast-Furnace Slag Cement (C 205–48 T). It was the primary purpose of this test program to obtain and present data to Committee C-1 for its consideration and vote of acceptance of N-Tair as an agent for inclusion in these specifications.[5] As a secondary objective, tests were included to evaluate the agent as an air-entraining admixture for concrete, and for this part of the program the preliminary proposed method of Committee C-9 on Concrete and Concrete Aggregates was followed essentially as outlined in the October, 1947, ASTM BULLETIN.[6]

SCOPE

Two groups of tests were undertaken, identified in this paper as groups I and II. Specimens for the group I tests were made in April, 1948, at the University of Wisconsin. For this group, type I and IA of (N-Tair interground) cements from only one mill were used, and solutions of N-Tair, Vinsol Resin (neutralized with NaOH), and Darex were added at the mixer in sufficient quantities to obtain air contents averaging 4.3 per cent in mixes containing 5 sacks of cement per cu. yd. Mixes containing 6.6 and 4.4 sacks of cement were also included in this group with N-Tair added at the mixer and interground with the cement. Tests in group I included chemical and physical tests of the cement, effect of aging on the physical properties of cements, properties of fresh concrete, compressive and flexural strength of concretes up to 1 yr., volume change of concretes during water and air storage, and freezing-and-thawing tests at Kansas State College on concrete beams made at the University of Wisconsin.

Specimens for the group II tests were made in July, 1948, at the same laboratory as those for group I. For this group an outline of tests was carefully prepared with the guidance of the A.S.T.M. C-1 Working Committee on Additions. The cements were ground with and without N-Tair at six different plants. Two plants supplied type I and IA, two type II and IIA, one type III and IIIA, and one type IS and IS-A. Concrete specimens were made with a cement content of 4½ sacks per cu. yd. and a 5-in. slump (simulating concrete for certain foundation and structural work where high strength is not required), and with a cement content of 6 sacks per cu. yd. and a 3½-in. slump (simulating concrete for pavements or high-strength structures). Tests in group II included chemical and physical tests of cements, properties of fresh concrete, compressive and flexural strengths of concrete up to an age of 1 yr., volume change of mortars during water and air storage, exposure to sulfate solutions, and freezing-and-thawing tests at Purdue University on beams made at the University of Wisconsin.

MATERIALS

Air-Entraining Agents:

The names, manufacturers, and definitions of the three air-entraining agents used in this program and the method used in adding each are described below:

N-Tair.—A material manufactured by Newport Industries, Inc., consisting substantially of a sodium resinate produced from the hydrocarbon extract of pine wood stumps from which the bulk of the petroleum naphtha soluble resin acids has been removed. The resin, if regenerated from the soap, has an acid number not less than 125. The N-Tair has been carefully stabilized so that it will remain homogeneous and completely soluble at all working concentrations.

This agent was supplied in a 60 per

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[5] 1948 Supplement to Books of A.S.T.M. Standards, Part II, pp. 101, 104.

[6] A.S.T.M. BULLETIN, No. 161, October, 1949, p. 7.

TABLE I.—CHEMICAL TESTS OF CEMENTS FOR GROUPS I AND II.

Cement		Approximate N-Tair Addition, per cent Dry Solids by Weight	Chemical Analysis, per cent								Alkali Content,[b] per cent		Compound Composition, per cent			
Manufacturer	Type		SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	SO_3	Loss on Ignition	Insoluble Residue	K_2O	Na_2O	C_3S	C_2S	C_3A	C_4AF
A[a]	I	0	20.14	7.38	2.77	62.78	3.59	1.83	0.73	0.17	0.54	0.26	44	25	15	8
A[a]	IA	0.011	20.12	7.35	2.77	62.53	3.61	1.93	0.68	0.16	0.54	0.26	43	25	15	8
B	I	0	21.40	7.31	2.77	61.70	2.98	2.00	0.62	0.31	1.00[c]	0.36[c]	30	39	15	8
B	IA	0.010	21.38	7.29	2.79	61.70	2.98	2.06	0.60	0.31	1.00[c]	0.36[c]	30	39	15	8
C	I	0	20.5	6.5	2.8	63.5	2.3	2.3	1.2	0.12	0.24	0.12	48	22	13	9
C	IA	0.009	20.5	6.6	2.8	63.4	2.3	2.2	1.4	0.15	0.23	0.12	48	23	13	9
D	II	0	24.02	4.16	3.72	63.91	1.75	1.39	0.55	0.18	0.37	0.24	40	39	5	11
D	IIA	0.011	24.10	4.28	3.48	64.04	1.71	1.28	0.66	0.21	0.37	0.24	40	39	5	11
E	II	0	21.40	5.81	4.19	62.65	2.20	1.66	0.60	0.30	0.65	0.25	43	29	8	13
E	IIA	0.0065	21.40	5.88	4.22	62.65	2.20	1.68	0.60	0.30	0.65	0.25	42	30	8	13
A	III	0	19.98	6.82	3.12	63.25	2.61	2.06	1.34	0.15	0.54	0.26	49	20	13	9
A	IIIA	0.017	19.80	7.25	2.90	63.16	2.65	2.25	1.15	0.14	0.54	0.26	47	21	14	9
F	IS	0	25.80	9.18	3.42	57.60	0.72	1.72	0.07	0.48	0.10	0.16	..	..	..	..
F	IS-A	0.011	25.54	9.41	3.81	56.80	1.01	1.51	0.08	0.87	0.10	0.16	..	..	..	..

[a] These cements used in group I tests; all others used in group II tests.
[b] Average values for cement produced at each mill at period when test cements were manufactured, except for the values for manufacturers B and C, where alkali contents of test cements were actually determined.
[c] Determination made on 50 per cent type I and 50 per cent type IA.

cent solids form and for additions at the concrete mixer was diluted with water to a 10 per cent solids solution. Concrete batch quantities of this diluted solution were carefully weighed out and added to the mixing water. For production of the air-entraining cements, the N-Tair was also diluted and added to the clinker as described in the next section on Identification and Manufacture of Test Cements.

Vinsol Resin.—A material manufactured by the Hercules Powder Co. consisting substantially of the petroleum-hydrocarbon insoluble fraction of a coal-tar hydrocarbon extract of pine wood.

This agent was supplied in a dry flake form and made into a sodium resinate solution by mixing together 20 g. of Vinsol Resin, 3.34 g. of commercial sodium hydroxide, and sufficient distilled water to make 100 g. of solution. Concrete batch quantities of this solution were carefully weighed out and added to the mixing water.

Darex AEA.—A material manufactured by the Dewey & Almy Chemical Co. consisting substantially of a triethanolamine salt of a sulfonated hydrocarbon.

This agent was supplied in a liquid containing 14.3 per cent solids (determined by evaporation). Concrete batch quantities were carefully weighed out and added to the mixing water.

Identification and Manufacture of Test Cements:

The cements for this test program were ground in commercial mills with and without N-Tair, and are identified as follows:

Identification of Manufacturer in Report	A.S.T.M. Types of Cement	Location of Mill
A	I, IA	Lehigh Valley
B	I, IA	Lehigh Valley
C	I, IA	Chicago Area
D	II, IIA	Hudson Valley
E	II, IIA	Hudson Valley
A	III, IIIA	Lehigh Valley
F	IS, IS-A	Western Pennsylvania

The first type I and IA cements listed above (manufacturer A) were produced on April 9, 1948, and used in the group I tests. All other cements were manufactured during the months of May, June, and July, 1948, and used in the Group II tests.

At each plant, the plain (non-air-entraining) and N-Tair cements were ground to about equal surface areas under similar conditions, attempting to produce the two cements as nearly alike as possible except for the addition of N-Tair. The procedures, however, were not identical at all six plants and are described briefly below.

For the type I and IA cements produced by manufacturers A and B, and the type II and IIA cements produced by manufacturer D, the plain and N-Tair cements were ground simultaneously in mills with output of 40 to 46 bbl. per hr. each and operating at mill temperature of about 230 to 250 F. For the air-entraining cement, the N-Tair was diluted (6 per cent solids for manufacturer A and 10 per cent for manufacturers B and D) and added directly to the mill feed at one- or two-minute intervals in predetermined quantities measured out in a glass graduate. At the start of the run, an estimate was made of the quantity of N-Tair solution that would be required to produce a mortar air content of about 18 per cent (based on approximate mill output figures). Then if the desired mortar air content was not obtained, the quantity of N-Tair solution was changed accordingly. During the grinds, samples of both the plain and N-Tair cements were taken from the mill discharges at about ½- to 1-hr. intervals for fineness and mortar air-content determinations. The grinds were continued until the finenesses of the plain and N-Tair cements were about the same and the mortar air content of the N-Tair cement was well within the specified 18 ± 3 per cent range. This required 2 to 5 hr. time. Then the samples for the concrete test program were collected from the mill discharges in 5-gal. pails fitted with rubber sealed, airtight lids for shipment to Madison, Wis. In these plants, the air separators received the discharges of a battery of mills (generally about 8 to 10). Hence, samples had to be taken at each mill discharge rather than after passing through the air separator. This necessitated grinding with somewhat lower mill feed rates in order to obtain the specified fineness. Also, it made it impossible to obtain accurate data on exact percentage additions of N-Tair or on any grinding aid effect of the agent, since the output of each individual mill could only be estimated.

At the plant of manufacturer E, the type IIA cement was ground in a 3-compartment "Unidan" mill with output of about 95 bbl. per hr. operating at a mill temperature of about 290 F. The N-Tair was diluted to 10 per cent solids and added to the "Unidan" using a graduate as described above, and samples taken periodically from the discharge of the mill during a 3-hr. period. These samples were then blended to give a final cement with desired mortar air content and with fineness comparable to that of the plain cement. The latter was composed of a blend of samples taken from the Unidan discharge and from the straight tube mills just before the N-Tair grind was made.

The type III and IIIA cements were produced by manufacturer A in the same general manner as the type I and IA cements except that a surface area of only 2320 sq. cm. per g. could be obtained with the cements taken from the tube mill discharge, and a second stage grind in a laboratory mill was employed to raise the fineness to that required in order to meet the strength specifications. The laboratory mill was a 24 by 30-in. stone-lined Patterson mill charged with steel balls which were preheated to about 225 F. Another difference from the procedure with the type IA cement was that because of the larger percentage

TABLE II.—PHYSICAL TESTS OF CEMENTS FOR GROUPS I AND II.

Cement		Approximate N-Tair Addition, per cent dry solids by weight	Specific Surface (Wagner), sq. cm. per g.	Autoclave Expansion, per cent	Time of Set,[b] min.		Mortar Air Content, per cent[c]		Water for Normal Consistency, per cent	Compression Test				Tensile Strength of Standard Mortar Briquets, psi.			
										Water-Cement Ratio, by Weight	Flow, per cent	Compressive Strength of Plastic Mortar Cubes, psi.						
Manufacturer	Type				Initial	Final	Manufacturer's Test	N. I. Test				1 day	3 days	7 days	28 days	1 day	3 days	7 days	28 days
A[a]	I	0	1765	0.209	155	330	7.3	..	23.0	0.52	106	..	2015	2850	4385	..	362	447	458
A[a]	IA	0.011	1674	0.222	185	435	20.3	..	24.0	0.49	105	..	1785	2615	3785	..	318	427	445
B	I	0	1820	0.25	120	285	5.5	6.2	24.0	0.50	100	465	1520	2470	4033	142	320	405	513
B	IA	0.010	1735	0.24	135	300	17.4	19.8	24.0	0.48	112	445	1460	2190	3758	128	298	385	450
C	I	0	1885	0.10	195	375	6.3	8.4	25.5	0.50	112	..	1890	3040	4540	..	328	405	492
C	IA	0.009	1865	0.10	195	375	16.1	18.7	25.0	0.50	111	..	1655	2575	4115	..	280	372	423
D	II	0	1740	0.015	180	320	7.0	6.3	22.5	0.54	105	495	1210	2100	4160	143	270	367	487
D	IIA	0.011	1820	0.013	170	310	19.2	17.8	22.5	0.50	104	445	1340	2290	3660	137	290	347	390
E	II	0	1825	0.054	240	390	10.9	8.8	24.5	0.54	105	405	1300	1875	4000	135	263	312	427
E	IIA	0.0065	1750	0.029	240	390	17.2	18.9	24.0	0.54	110	440	1300	1750	3850	133	272	312	417
A	III	0	2678	0.152	90	275	6.5	5.6	28.0	..	..	1265	3400	4590	5665	282	422	468	528
A	IIIA	0.017	2687	0.224	84	220	18.2	16.4	25.5	0.50	..	1500	3365	4450	5135	305	428	448	508
F	IS	0	2390	0	160	315	9.5	5.2	27.0	0.52	105	..	1750	2650	5515	..	332	453	560
F	IS-A	0.011	2310	0.614	200	380	16.1	16.6	26.0	0.52	107	..	1140	2060	5035	..	333	393	487

[a] These cements used in group I tests; all others used in group II tests.
[b] Determined by Gillmore needle for cements B, C, D, and E, and by Vicat needle for all others.
[c] Tests by manufacturers made using hand mixing in standard bowl; tests by Newport Industries (N. I.) made using machine mixing in Hobart mixer; Burmeister trough used in both cases.

of agent required with type IIIA cement, the N-Tair was diluted to 20 per cent solids rather than 6 per cent in order that the quantity of water added to the mill would not be excessive and possibly become a factor. No difficulties were encountered in adding this solution.

The type IS and IS-A cements produced by manufacturer F were ground simultaneously in identical Allis-Chalmers 8726 2-compartment mills equipped with air separators. Duration of grind was 10 hr. Samples were taken during last 2 hr. of the grind.

For the cements produced by manufacturer C, the type I cement contained no additive and the type IA cement contained 0.015 per cent N-Tair prepared by blending seven parts of the type I cement with three parts of cement interground in a production tube mill with 0.05 per cent N-Tair.

Complete chemical and physical tests of the cements were made in accordance with A.S.T.M. Standard Specifications (C 150–47, C 175–48 T, and C 205–48 T) at the control testing laboratories of the manufacturers (Tables I and II). In order to obtain directly comparable mortar air-content values for all cements with elimination of possible differences in hand-mixing techniques, samples of each were sent to the Research Laboratory of Newport Industries, Inc., where the tests were made using machine mixing in a Hobart Kitchen-Aid Mixer, Model K4-B. This mixer was found to provide closely reproducible results and to be very satisfactory for this mortar air test.

Aggregates:

Washed sand and gravel from Janesville, Wis., was used for all concretes made in this program. The sand was composed of approximately 60 per cent quartz, 30 per cent dolomite, and the remainder other materials including a trace of chert. The gravel was largely dolomite and contained approximately 3 per cent of chert particles. It was used in No. 4 sieve to $\frac{3}{8}$, $\frac{3}{8}$ to $\frac{3}{4}$, and $\frac{3}{4}$ to 1-in. sizes which were combined to give the grading indicated in Table III:

TABLE III.—PROPERTIES OF AGGREGATES

	Sand	Gravel
Dry rodded weight, lb. per cu. ft.	112	105
Apparent specific gravity	2.67	2.67
Absorption by weight in 30 min., in per cent	0.5	1.5
Grading: per cent passing		
1-in. sieve	100	100
¾-in. sieve	100	85
½-in. sieve	100	55
⅜-in. sieve	100	35
No. 4 sieve	100	0
No. 8 sieve	83.9	0
No. 16 sieve	69.4	0
No. 30 sieve	51.2	0
No. 50 sieve	15.9	0
No. 100 sieve	2.4	0
Fineness modulus	2.77	6.80

Methods of Test

Fabrication of Concrete Specimens:

The sand and gravel were used in a laboratory air-dry condition and moisture contents and absorptions determined for use in calculation of water-cement ratios. Batches were mixed in a 1¼-cu. ft. revolving drum mixer, the size of batch being generally the capacity of the mixer. Batches were mixed for about ½ min. dry, then the major portion of the mixing water (containing the air-entraining agent when used) was added and the mixing continued. The remainder of the water needed to obtain the desired slump was gaged by eye, making small successive additions during the next 3 to 4 min. of mixing. Batches were always mixed for at least a minute after all water had been added. The total wet-mixing time was 5 min.

Batches were discharged from the mixer into a metal tray, turned over once with a shovel, and slump, unit weight, and pressure-type air meter tests made before casting specimens. Batches that did not have the desired slump or air content were discarded and repeated with a changed amount of water or air-entraining agent. When air-entraining agents were added at the mixer (group I), the amount of agent was established for the first round and was kept the same for successive rounds. In Tables IV and V the values for the concrete properties are averages of two to six tests.

Cylinders, beams, and prisms were cast in steel molds according to standard methods. Generally, three specimens of a kind were made from separate batches. Molds were stripped at the age of 1 day.

Concrete Strength Tests:

Cylinders for compression tests were moist cured, capped, and tested in a 300,000 lb.-hydraulic machine. Beams for flexural strength tests were moist cured and tested in the as-cast position (6 in. depth) using center point loading over a 20-in. span.

Volume Change Tests:

In group I, prisms were included for volume change measurements of the 5 sack cement per cu. yd. concretes with 2½-in. slump. These prisms were equipped with stainless steel reference points in each end for length change measurements with a comparator. Prisms for expansion measurements were stored in tanks of water in the laboratory, and those for contraction measurements were stored in air at approximately 70 F. and 50 per cent relative humidity.

In group II, 1 by 1 by 6-in. mortar bars were made for volume change tests

TABLE IV.—CONCRETE MIX PROPERTIES AND STRENGTH RESULTS FOR GROUP I.

Type of Cement	Air-Entraining Agent Added at Mixer			Properties of Fresh Concrete					Strength Test Results, psi. (Moist Curing)							Strength Tests of 3 by 4 by 16-in. Beams at End of Freezing and Thawing			
									Compressive Strength, 6 by 12-in. Cylinders				Flexural Strength 4 by 6 by 24-in. Beams (Center Loading, 20-in. Span)						
	Kind	Dry Solids, per cent by Weight of Cement	Sand, per cent by Weight of Total Aggregate	Net[b] Water-Cement Ratio, gal. per Sack	Slump, in.	Specific Weight, lb. per cu. ft.	Cement Content, Sacks per cu. yd.	Net Air Content (Pressure Meter), per cent	2 days	7 days	28 days	1 yr.	7 days	28 days	1 yr.	Number of Cycles	Drop in Dynamic Modulus, per cent	Compressive Strength of Modified Cubes, psi.	Flexural Strength, psi. (Center, Loading 14-in. Span)
CEMENT CONTENT = 5.0 SACKS PER CU. YD. SLUMP = 2½ ± ½ IN.																			
I	None	0	43	6.65	2.5	151.4	4.99	1.6	1060	3140	4860	6865	512	718	883	135	69	3365	357
I	N-Tair	0.0060	39	5.89	2.2	148.0	5.01	4.3	1190	3030	4640	6160	546	707	864	210	16	3645	536
I	Vinsol Resin	0.0100[a]	39	5.94	2.4	148.3	5.02	4.3	1160	3160	4805	6390	518	750	880	200	24	3405	340
I	Darex	0.0095	39	5.94	2.4	147.5	4.99	4.3	1230	3170	4730	6025	511	673	879	210	11	3490	532
IA	None	0	39	6.16	2.5	147.7	4.99	4.2	1050	2850	4665	6045	513	687	856	210	11	3090	542
CEMENT CONTENT = 5.0 SACKS PER CU. YD. SLUMP = 5 ± ½ IN.																			
I	None	0	43	7.02	5.2	150.7	4.98	1.5	..	2880	5210	..	..	721	..	..	..	..	..
I	N-Tair	0.0060	39	6.30	4.6	146.8	5.00	4.6	..	2940	4630	..	..	634	..	..	..	..	..
IA	None	0	39	6.37	5.2	144.6	4.93	6.3	..	2200	3520	..	..	585	..	..	..	..	..
CEMENT CONTENT = 6.6 SACKS PER CU. YD. SLUMP = 2½ ± ½ IN.																			
I	None	0	37	4.85	2.4	152.5	6.60	1.5	..	..	..	9050	..	..	1055	200	27	4265	523
I	N-Tair	0.0090	33	4.48	1.9	150.9	6.64	3.5	..	..	..	7680	..	..	1066	210	7	4585	680
IA	None	0	33	4.78	2.4	151.5	6.64	3.0	..	..	..	7700	..	..	1097	210	16	4490	511
CEMENT CONTENT = 4.0 SACKS PER CU. YD. SLUMP = 5 ± ½ IN.																			
I	None	0	45	9.15	5.3	149.8	4.00	1.6	..	..	..	4230	..	..	690	143	50	2750	383
I	N-Tair	0.0040	41	7.76	5.0	147.8	4.05	4.2	..	..	..	4105	..	..	650	210	12	2605	402
IA	None	0	41	8.00	5.0	144.8	3.98	5.5	..	..	..	3605	..	..	609	210	15	2365	447

[a] Total per cent solids V. R. + NaOH (per cent Vinsol Resin = 0.0092).
[b] Total water added minus water absorbed by aggregates.

TABLE V.—CONCRETE MIX PROPERTIES AND STRENGTH RESULTS FOR GROUP II.

Cement		Properties of Fresh Concrete						Strength Test Results, psi. (Moist Curing)								Strength Tests of 3 by 4 by 16-in. Beams at End of Freezing and Thawing		
								Compressive Strength, 6 by 12-in. Cylinders					Flexural Strength, 4 by 6 by 24-in. Beams					
Manufacturer	Type	Cement Content, sacks per cu. yd.	Slump, in.	Sand, per cent by Weight of Total Aggregate	Net[a] Water-Cement Ratio, gal. per Sack	Specific Weight, lb. per cu. ft.	Net Air Content (Pressure Meter), per cent	1 day	7 days	28 days	6 mo.	10 mo. or 1 yr.[b]	7 days	28 days	6 mo.	Number of Cycles	Drop in Dynamic Modulus, per cent	Flexural Strength, psi. (Third-point Loading, 15-in. Span)
B.....	I	4.46	5.3	44	7.98	149.6	1.5	..	1770	3305	4530	4920	425	627	809	275	29	377
B.....	IA	4.50	4.8	40	6.71	145.0	6.0	..	1730	3225	4215	4585	403	544	761	275	4	448
B.....	I	5.97	3.4	39	5.65	151.5	1.3	..	3210	5150	6345	7360	572	682	985	125	57	242
B.....	IA	6.00	3.4	35	5.12	147.9	4.1	..	3000	4320	5745	6375	504	676	846	200	19	473
C.....	I	4.49	5.0	44	7.74	148.6	1.5	..	1895	3370	4635	5105	461	611	744	275	15	401
C.....	IA	4.49	4.9	40	6.62	143.0	6.1	..	2140	3280	4635	4885	457	585	705	275	16	451
C.....	I	6.00	3.2	39	5.49	150.7	1.6	..	3535	5420	6895	7615	622	783	953	200	35	290
C.....	IA	6.01	3.2	35	5.04	147.5	4.0	..	3520	5110	6645	6835	515	708	862	200	8	634
D.....	II	4.49	5.0	44	7.77	150.3	1.2	..	1650	3080	5055	5525	397	597	813	275	20	440
D.....	IIA	4.49	5.3	40	6.70	144.7	5.9	..	1620	3080	4585	5345	380	542	838	275	4	474
D.....	II	6.00	3.4	39	5.39	151.8	1.2	..	3130	5060	6990	7545	569	710	933	200	47	356
D.....	IIA	5.98	3.5	35	5.05	148.5	3.9	..	2885	4530	6275	7375	563	735	887	200	25	419
E.....	II	4.45	5.1	44	7.79	148.8	2.3	..	1875	3155	4835	5075	390	569	810	275	12	436
E.....	IIA	4.48	5.0	40	6.73	145.0	5.5	..	1900	3215	4695	4780	415	556	771	275	13	389
E.....	II	6.00	3.2	39	5.36	151.7	1.8	..	3670	5170	7095	8010	594	709	963	200	54	300
E.....	IIA	5.98	3.4	35	5.06	148.7	3.8	..	3110	4540	6365	6770	526	700	842	200	32	379
A.....	III	4.50	4.8	44	7.59	149.2	1.4	845	2950	4250	5255	5555	568	674	789	75	59	220
A.....	IIIA	4.52	5.0	40	6.90	145.6	4.6	1165	3070	3870	4765	4805	560	653	732	200	22	394
A.....	III	6.01	3.4	39	5.57	151.1	1.3	1745	4610	5900	7115	7365	664	760	971	75	56	293
A.....	IIIA	6.03	3.4	35	5.19	148.3	3.1	1995	4320	5230	6365	7315	646	748	923	200	27	439
F.....	IS	4.46	5.0	44	7.81	149.4	1.2	..	1735	3235	5235	5670	398	610	865	250	42	263
F.....	IS-A	4.46	4.8	40	6.78	145.3	5.4	..	1745	3515	5160	5520	370	553	766	250	13	428
F.....	IS	5.98	3.3	39	5.53	151.6	1.1	..	3280	5550	7230	7585	556	748	969	125	49	285
F.....	IS-A	5.98	3.1	35	5.23	149.4	2.6	..	3175	5020	6710	6450	533	713	895	200	25	517

[a] Total water added minus water absorbed by aggregates.
[b] Results for cements from manufacturers C, E, and F are 1-yr. results, all others 10 months.

using standard Ottawa sand and a 1:3 mix by weight. Water was gaged to obtain a flow of 100 per cent to 115 per cent on a standard 10-in. table. Four bars were made from each batch with each cement, two for storage in water and two for storage in air at approximately 70 F. and 50 per cent relative humidity.

Freezing-and-Thawing Tests; Group I Program:

Concrete beams, 3 by 4 by 16 in., were made at the University of Wisconsin, moist cured for 14 days, and stored 6 months in air. During the air-curing period they were shipped to Kansas State College. When all beams were substantially 6 months old, freezing-and-thawing tests were started. Prior to starting the tests all beams were immersed in water for 3 days. The initial dynamic moduli were then determined and the freezing-and-thawing tests begun.

For the first 100 cycles the beams were frozen in air at −20 F. and thawed in water at 75 F. twice daily, the specimens remaining in the freezer overnight and through Sunday. During this period none of the beams showed any loss in dynamic modulus. It was then decided to freeze and thaw the beams immersed in water. In this cycle the beams were enclosed in close-fitting metal containers, the space between the beams and the containers was filled with tap water, and the container placed in alcohol at −20 F. Two cycles were secured each day, and the beams left in the freezer overnight and Sunday. A gradual loss of mortar from the surfaces of the beams commenced at once on the non-air-entrained concrete, and losses in dynamic modulus began to appear.

Periodic tests of dynamic modulus of elasticity were made by vibrating the beams about the 4-in. axis. The per cent drop in modulus was calculated for each beam by using the value at the beginning of the test (the end of the 3-day soaking period) as the basis for comparison. At the time freezing-and-thawing tests were discontinued on a set of beams, the flexural strengths were determined about the 4-in. axis, and compressive strengths determined on the beam ends (modified cubes) with a 4-in. face vertical.

Freezing-and Thawing Tests; Group II Program:

Concrete beams 3 by 4 by 16 in. were made at the University of Wisconsin and moist cured there for 14 days. They were then weighed and curing continued in air for a period of 2 to 3 weeks, during which time they were shipped to Purdue University. All beams were at least 28 days old when freezing-and-thawing tests were started. Prior to starting the tests, the beams were weighed and then soaked half immersed in water for 5 days with the troweled surfaces vertical. The initial dynamic moduli of elasticity were then determined, and the freezing-and-thawing tests begun.

For the first 200 cycles, the beams were frozen in air and thawed in water twice a day. An additional 75 cycles to which some of the beams were subjected consisted of one cycle per day of freezing half-immersed in water (troweled surface vertical) and thawing in water. Beams remained in the freezer overnight and Sunday.

Periodic tests of dynamic moduli of elasticity were made to determine the amount of deterioration due to freezing and thawing. The per cent drop in dynamic modulus (based on frequency of vibration in the direction of the 4-in. dimension) was calculated for each beam using the value at the end of the soaking period as 100 per cent.

Freezing and thawing temperatures were approximately −10 F. and 60 F., respectively. Freezing was accomplished in a walk-in type freezer which lowered the temperature at the center of 3 by 4 by 16-in. beams to −10 F. in 4 hr. when frozen in air and in 7 hr. when frozen partially immersed in water. Thawing was done in concrete tanks with running tap water. The beams were completely immersed and the temperature at the center of the beams reached 60 F. in 1½ hr.

At the time freezing-and-thawing tests were discontinued on a set of beams, the flexural strengths were determined using third-point loading on a 15-in. span with the load applied on the 3-in. sides of the beams.

Sulfate Exposure Tests:

In group II, concrete beams were made from the mixes containing 6 sacks cement per cu. yd., for sulfate exposure tests made in accordance with a procedure outlined by the C-1 Working Committee on Additions. Beams were moist cured 28 days, then placed on their sides in shallow tanks. The tanks contained enough sand to imbed the beams to a depth of 1 in. and also provide a 1-in. layer of sand between the bottom of the beams and the bottom of the tank. Enough sulfate solution was added to raise the solution level to a point 1 in. below the upper surface of beams. The solution consisted of one part of a 10 per cent solution of magnesium sulfate and two parts of a 10 per cent solution of sodium sulfate. Tanks were placed out of doors for first 2 months with cover supported about 8 in. above them. This did not, however, prevent driving rains from entering the tanks. Level

TABLE VI.—EFFECT OF AGING ON PHYSICAL PROPERTIES OF CEMENTS OF GROUP I.

Age When Tested	Storage of Cement[a]	Type of Cement	Time of Set (Gillmore), min.		Water for Normal Consistency, per cent	Compression Test							Tension Test						
						Water-Cement Ratio, by weight	Flow, per cent	Compressive Strength of Plastic Mortar Cubes, psi.					Water, per cent by weight of Cement + Sand	Tensile Strength of Standard Mortar Briquets, psi.					
			Initial	Final				1 day	3 days	7 days	28 days	6 mo.	1 yr.		1 day	3 days	7 days	28 days	6 mo.	1 yr.
2 months...	A	I	210	300	23.5	0.57	110	415	2005	3295	5515	5770	5775	10.4	190	350	405	450	415	430
		IA	210	300	23.5	0.57	110	380	1800	2980	4535	4860	4780	10.4	195	305	385	410	405	390
	B	I	255	435	23.5	0.53	115	..	..	2195	3475	..	..	10.4	..	..	360	505	..	..
		IA	255	435	23.5	0.53	110	..	..	2460	3715	..	..	10.4	..	..	385	480	..	..
	C	I	270	435	23.5	0.52	103	..	..	1935	3245	..	..	10.4	..	..	350	460	..	..
		IA	270	435	23.5	0.52	100	..	..	1975	3305	..	..	10.4	..	..	375	470	..	..

[a] Storage conditions: A—In pasteboard containers with tight lids, in first-floor laboratory room. B—2 mo. storage "A," then in cloth cement sacks in first-floor room supported on wood off of concrete floor. Some soft lumps found in cement. Sample screened through 10-mesh sieve before using. C—2 mo. storage "A," then in cloth cement sacks in basement room supported on wood off of concrete floor. Somewhat more soft lumps found than in storage "B." Sample screened through No. 10 sieve before using.

of solution was maintained by alternate additions of sulfate solution and water. After 2 months the tanks were brought indoors for the winter and the solution replaced with new; water losses from evaporation were replaced as needed.

Discussion of Results

Chemical and Physical Properties of Cements:

Tables I and II give the chemical and physical properties of the cements used in this program. It will be noted that the chemical compositions of the plain and air-entraining cements from a given manufacturer were almost identical in all cases. Specific surfaces of companion plain and air-entraining cements were also in close agreement, although, generally the plain cement was slightly finer.

In both the compressive and tensile strength tests, the air-entraining cement specimens generally showed somewhat lower (averaging 7 per cent excluding 1-day values) strengths than those made with the companion plain cements. The differences, however, are in line with the experience of the cement manufacturers, and all cements met all of the A.S.T.M. specification requirements.

Aging of Cement:

In order to determine whether or not there would be any differences in effect of storage or aging on the physical properties of plain cement and that ground with N-Tair, a few tests were made as shown in Table VI. These tests show a decided reduction in compressive strength with both cements when stored for 1 yr., and, if anything, a slightly smaller reduction with the air-entraining cement.

Physical Properties of Fresh Concrete:

Physical properties of the concrete mixes for groups I and II are given in Tables IV and V. The percentages of sand for the plain concrete mixes were selected from past experience with these aggregates in the laboratory and observation of workability of the first mixes. It will be noted that for the air-entrained concretes, the percentage of sand was reduced 4 per cent below that used for plain cement mixes of the same cement content. This reduction was selected following the suggestion given in the "Proposed Method of Evaluation of Air-Entraining Admixtures for Concrete," given in the ASTM Bulletin, October, 1947, and was found to produce workable mixtures that appeared to have about the correct proportion of sand.

Although the plain concrete mixes appeared to be of good workability, there was a definite improvement observed in the plasticity and cohesiveness of the air-entrained concretes. This improvement was especially apparent in the leaner mixes.

Water requirements for the air-entrained concretes ranged up to 1.5 gal. per sack less than for corresponding plain mix concretes; as expected, the largest reductions were obtained in the leaner mixes. In the group II tests (Table V), the reduction in water-cement ratios of air-entrained concretes from those of corresponding plain concretes averaged 1.0 and 0.4 gal. per sack for the $4\frac{1}{2}$ and 6 sacks cement per cu. yd. mixes, respectively.

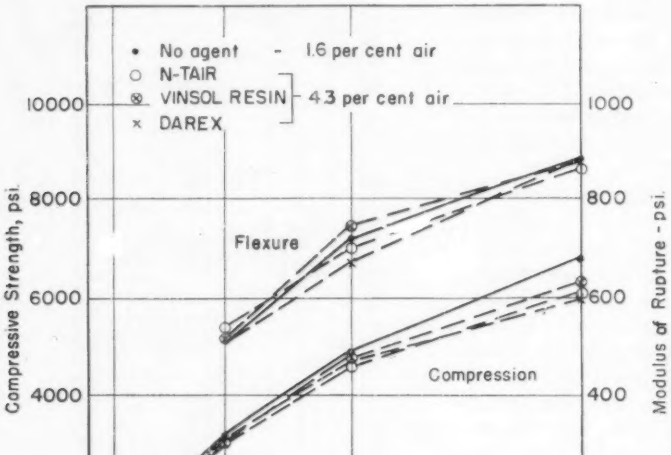

Fig. 1.—Effect of Air-Entraining Agents on Strength of Concrete.

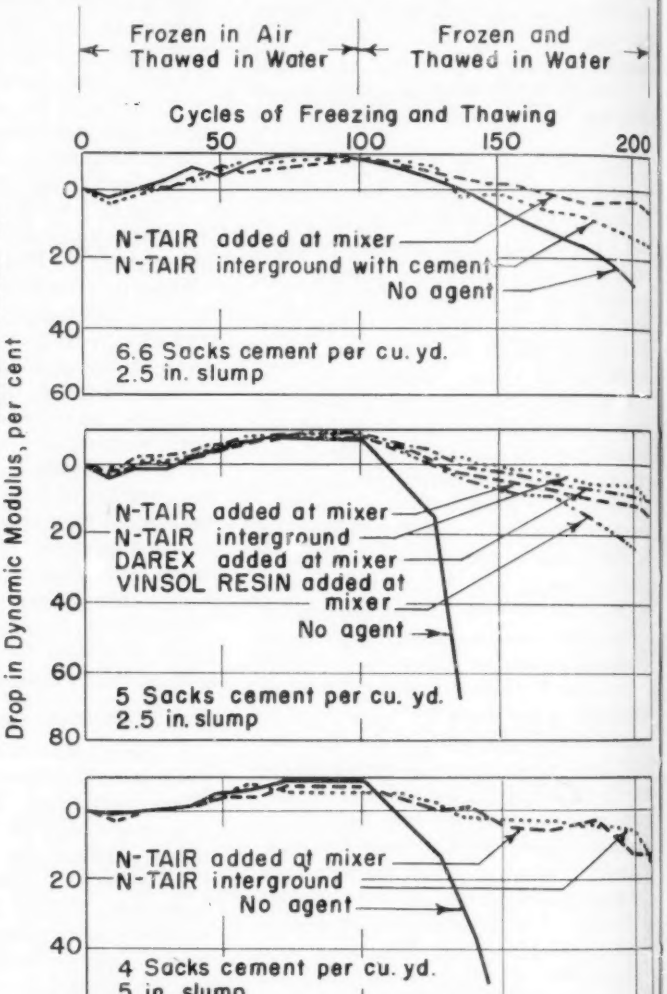

Fig. 2.—Drop in Dynamic Modulus of Elasticity of Group I Concrete Beams During Freezing and Thawing.

For most of the mixes where the air-entraining agents were added at the mixer, the amount of agent was adjusted to give an air content between 4 and 5 per cent. Where the air-entraining agents were interground with the cement, the amount of agent was adjusted

TABLE VII—STRENGTH DECREASES DUE TO AIR ENTRAINMENT.

Group	Type of Cement	Cement Content, Sacks per cu. yd.	Slump, in.	Agent		Air Content, per cent	Percentage Decrease in Strength from Corresponding Plain Concrete (+ Sign Indicates Increase)									
							Compression						Flexure			
				Name	How Added		2 days	7 days	28 days	6 mo.	10 mo.	1 yr.	7 days	28 days	6 mo.	1 yr.
I	I	5	2.2	N-Tair	At mixer	4.3	+12	3	4	..	..	10	+7	1	..	2
	I	5	2.4	Vinsol Resin	At mixer	4.3	+ 9	0	1	..	..	7	+1	+4	..	0
	I	5	2.4	Darex	At mixer	4.3	+16	+1	3	..	..	12	0	6	..	0
	IA	5	2.5	N-Tair	Interground	4.2	1	9	4	..	..	12	0	4	..	3
II	IA[a]	4½	4.8	N-Tair	Interground	6.0	..	+5	2	3	7	4	3	9	5	..
	IIA[a]	4½	5.1	N-Tair	Interground	5.7	..	0	+1	6	3	6	+1	6	1	..
	IIIA	4½	5.0	N-Tair	Interground	4.6	+38[b]	+4	9	9	13	..	1	3	7	..
	IS-A	4½	4.8	N-Tair	Interground	5.4	..	+1	+9	1	..	3	7	9	11	..
	IA[a]	6	3.3	N-Tair	Interground	4.0	..	4	11	7	13	10	15	5	12	..
	IIA[a]	6	3.4	N-Tair	Interground	3.8	..	12	11	10	2	15	6	+1	9	..
	IIIA	6	3.4	N-Tair	Interground	3.1	+14[b]	6	11	10	1	..	3	2	5	..
	IS-A	6	3.1	N-Tair	Interground	2.6	..	3	10	7	..	15	4	5	8	..

[a] Average for cements from two manufacturers except for 10-mo. and 1-yr. values, which are for cements from separate, individual manufacturers.
[b] Tests at 1-day age instead of 2 days.

to obtain a mortar air content in about the middle of the specified range, and the air contents of the concretes varied with richness and consistency of the mixes. For the group II mixes the air contents of the air-entraining cement mixes averaged 5.6 per cent and 3.6 per cent for those containing 4½ and 6 sacks cement per cu. yd., respectively.

Concrete Strength:

Compressive and flexural strength results for groups I and II are given in Tables IV and V. The effects of additions of different air-entraining agents on the strength of concretes made with 5 sacks of cement per cu. yd. and 2½-in. slump are shown in Fig. 1. No significant differences in strengths were obtained with the three different agents added at the mixer. Generally the air-entrained concretes had slightly lower strengths than the companion plain concretes except at the very early ages. As shown in Table VII, these strength decreases were variable but did not exceed 15 per cent in any case.

Volume Change:

Expansions due to storage in water and contractions due to drying in air obtained with the concrete prisms of group I showed no significant differences for the plain concretes and those made with the different air-entraining agents. At the end of 1 yr., expansions of only 0.02 per cent were obtained in every case, while the contractions due to air drying were only 0.04 per cent.

Test results obtained from the mortar bars, group II, stored in water and in air again showed no significant differences in expansion or contraction between the plain and the companion air-entraining cement mortar bars. Nearly all expansions due to 10 months of water storage were less than 0.01 per cent. The contractions due to 10 months' storage in air were usually only slightly greater than 0.10 per cent except for the values for the type III and IIIA cements which were 0.17 and 0.15 per cent, respectively.

TABLE VIII—AIR CONTENT AND ABSORPTION DATA FOR GROUP II CONCRETE MIXES TESTED IN FREEZING AND THAWING.

Cement			Original Air Content, per cent	Change in Water Content, per cent by volume[b]	Relative Air Content, at Start of Freezing and Thawing, per cent[c]	Loss in Dynamic Modulus in 100 Cycle of Freezings and Thawing, per cent
Manufacturer	Type	Sacks per cu. yd.				
B.....	I	4½	1.5	−1.1	2.6	15
	I	6	1.3	+1.6	−0.3	48
	IA	4½	6.0	−0.7	6.7	12
	IA	6	4.1	+1.8	2.3	14
C.....	I	4½	1.4	−1.7	3.1	10
	I	6	1.6	−1.6	3.2	16
	IA	4½	6.1	−1.8	7.9	11
	IA	6	4.0	−1.7	5.7	10
F.....	IS	4½	1.2	−1.6	2.8	13
	IS	6	1.1	+0.8	0.3	46
	IS-A	4½	5.4	+0.1	5.5	15
	IS-A	6	2.6	+1.5	1.1	14
D.....	II	4½	1.2	−0.4	1.6	13
	II	6	1.2	+3.0	−1.8	25
	IIA	4½	5.9	+0.2	5.7	8
	IIA	6	3.9	+2.8	1.1	19
E.....	II	4½	2.3	−0.9	3.2	10
	II	6	1.8	+2.1	−0.3	36
	IIA	4½	5.5	+0.3	5.2	13
	IIA	6	3.8	+2.6	1.2	22
A.....	III	4½	1.4	−0.5	1.9	59[a]
	III	6	1.3	+0.2	1.1	56[a]
	IIIA	4½	4.6	+0.2	4.4	16[a]
	IIIA	6	3.1	+0.2	2.9	15[a]

[a] Losses in dynamic modulus at 75 cycles.
[b] Total change in water content, per cent by volume of the concrete, between end of moist curing and start of freeze and thaw. Specimens were air dried for 2 to 3 weeks and then partially immersed in water for 5 days during this period.
[c] Obtained by subtracting the change in water content from the original air content.

Sulfate Resistance:

The sulfate tests did not show any visible evidence of deterioration after 9 months for either the plain or the air-entrained concrete. Length measurements with a comparator also showed no evidence of volume change.

Resistance to Freezing and Thawing—Group I:

The test results for group I are shown in Table IV and Fig. 2. With few exceptions, the results of the freezing tests are the average of three beams. It was the original plan to consider a drop of 50 per cent in dynamic modulus as evidence of failure in the freezing-and-thawing test. It may be noted that only the non-air-entrained concretes with 4.0 and 5.0 sacks per cu. yd. reached this value before 200 cycles. All beams were tested at the end of 210 cycles in order that the various concretes might be compared. It is believed that significant results were achieved by that time, and that further exposure would not have given more significant results.

One of the significant observations in this test was that for the first 100 cycles of freezing in air and thawing in water, all concretes showed slight increases in dynamic modulus, indicating that no deterioration was occurring, and that some increased hydration was taking place. However, as soon as freezing immersed in water was started, the concretes began to deteriorate. The dynamic modulus was reduced immediately for the non-air-entrained concretes, and a very slight loss in surface mortar began to occur. Without exception, the air-entrained concrete gave superior resistance to freezing and thawing.

The rich mix showed superior resistance as compared with the leaner mixes in the non-air-entrained concrete, but not in the air-entrained concrete. However, the rich mix had less entrained air.

This series gives every indication that

the air entrainment was the important element in giving improved freezing-and-thawing resistance. It did not appear that the agent used or the method of securing air entrainment was a matter of significance.

Relative Durability of Air-Entrained and Non-Air-Entrained Concretes—Group II:

The test results for group II are shown in Table V. With few exceptions, the results shown are averages for three beams.

A drop of 50 per cent in dynamic modulus was considered as failure in the group II freezing-and-thawing tests. On the basis of this criterion, the non-air-entrained concretes made with type III cement, both the $4\frac{1}{2}$- and the 6-sack mixes, were discontinued at 75 cycles, with losses of 59 and 56 per cent, respectively. At 125 cycles, the 6-sack concretes made with non-air-entraining cements type IS and type I (manufacturer B) had dropped 49 and 57 per cent, respectively, and were discontinued. The flexural strength of each beam was determined at the time freezing and thawing was discontinued.

At the end of 200 cycles, only one of the other concretes had dropped 50 per cent in dynamic modulus. However, the differences in drop between the remaining air-entrained and non-air-entrained 6-sack concretes were sufficiently large to indicate significantly better durability with air entrainment. Freezing and thawing was, therefore, discontinued and the flexural strengths determined.

The remaining $4\frac{1}{2}$-sack concretes made with cements from manufacturers B, C, D, E, and F were then subjected to additional cycles. For these cycles, freezing in water (half immersion) was used. The concretes made with cement from manufacturer F (IS and IS-A) were discontinued after 50 additional cycles, and the rest after 75 cycles of freezing and thawing in water.

The flexural strengths show the same trends as do the drops in dynamic modulus, with the air-entrained concretes generally showing greater strength than the corresponding non-air-entrained concretes at the end of testing.

The relative durabilities of the air-entrained and non-air-entrained concretes are shown in Fig. 3. Significantly greater durability is shown by all air-entrained concretes except the $4\frac{1}{2}$-sack concretes made with cements from manufacturers C and E where no appreciable difference was found. In general, the relative increase in durability obtained by the use of the air-entraining agent was greatest for the concretes that were the least durable without air entrainment. The $4\frac{1}{2}$-sack

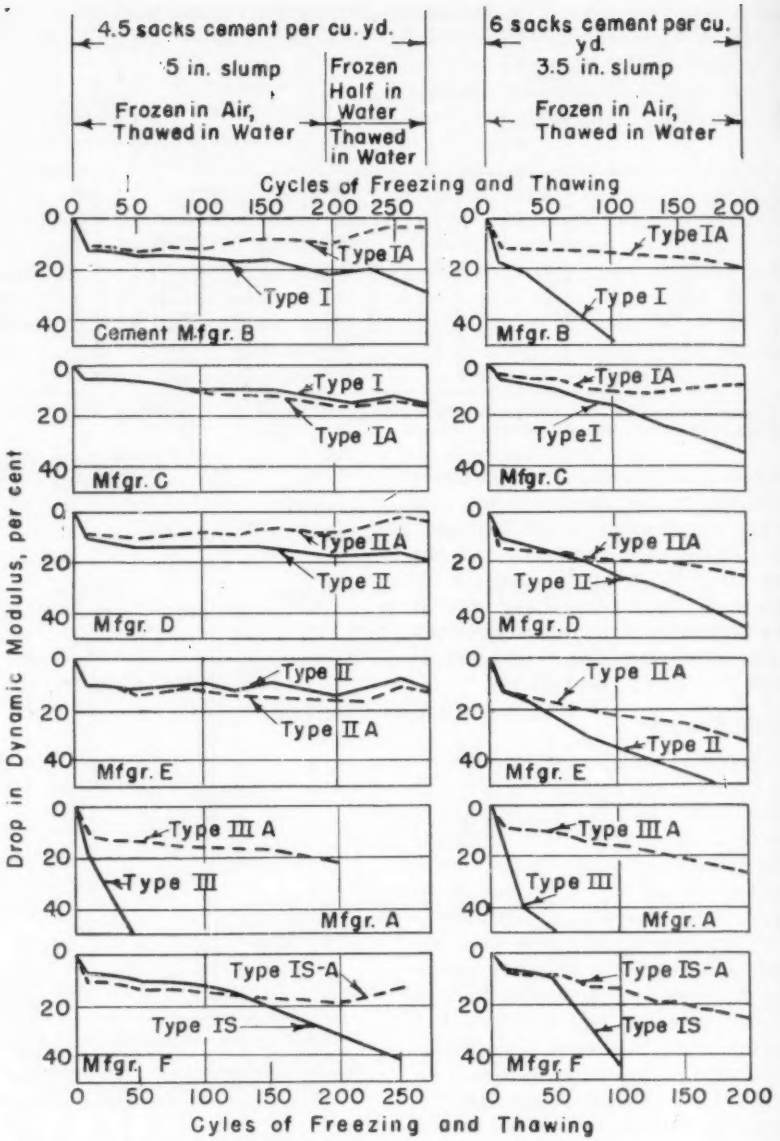

Fig. 3.—Drop in Dynamic Modulus of Elasticity of Group II Concrete Beams During Freezing and Thawing.

non-air-entrained concretes made with cements C and E were more durable than were any of the other non-air-entrained concretes. They might logically be expected to show less improvement with air entrainment.

Relative Durability of $4\frac{1}{2}$- and 6-Sack Concretes—Group II:

The data for the freezing-and-thawing tests of group II presented in Table V and in Fig. 3 show greater durability for the $4\frac{1}{2}$- than for the 6-sack concretes. The greater durability of the lean mix concretes is particularly evident in those made with non-air-entraining cement, but is also generally true, to a lesser degree, for the air-entrained concretes.

Durability of concrete in freezing and thawing is primarily dependent upon the percentage of voids filled with water at the time freezing takes place. The original air content and the amount of water gained or lost during curing are important factors in determining the percentage of voids filled or nearly filled with water (or the degree of saturation). The data on weight changes of the beams were therefore analyzed to see whether an explanation of the greater durability of the lean mix concretes could be found.

Table VIII shows, for each cement and cement content, the original air content and the change in water content (per cent of the volume of the concrete) between the end of moist curing and the start of freeze-and-thaw-testing. The values shown are the total changes in volume of water during the air-drying and partial immersion periods that immediately preceded testing. In the majority of cases, the rich mix concretes gained considerably in volume of water, while the lean mix concretes gained very

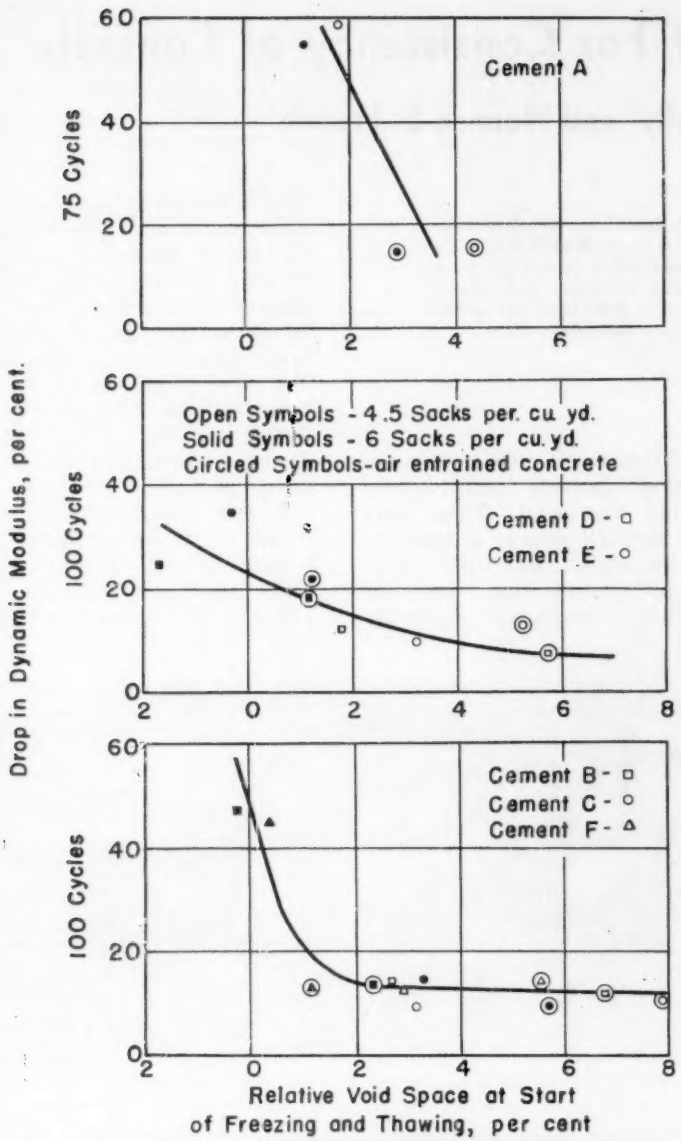

Fig. 4.—Relation Between Relative Void Space at Start of Freezing and Thawing and Durability of Group II Concretes.

little or lost water. From weights obtained at the end of the air-storage period, it appears that the lean mix concretes lost more water than the rich and then during the five days of half-immersion failed to regain all of the water lost; whereas the rich mix concretes generally gained even more water than had been lost.

The sixth column in Table VIII shows the values obtained by subtracting the gain in water from the original air content. These values may be considered as "relative" air contents at the time freezing and thawing was begun. Since no consideration is given such factors as (*a*) water utilized in hydration of the cement, (*b*) shrinkage of the concrete, and (*c*) loss or gain in water during the 14-day moist-curing period, the actual numerical values are inaccurate. However, it is believed that for similar materials, the figures are of value for comparative purposes, and indicate relative air contents and therefore probable degrees of saturation for the various concrete mixes. In all but one case (cement C) the relative air contents for the rich mixes were lower than for the corresponding lean mixes. The higher degree of saturation indicated for the 6-sack mixes is in line with their poorer durability.

In Fig. 4 the relative air contents at the start of freeze-and-thaw testing are plotted against the loss in dynamic modulus. The results for cements B and C (type I and IA) and cement F (type IS and IS-A) are shown in the lower plot. A definite relationship between durability and relative air content at the start of freeze-and-thaw testing is shown even though cements from three manufacturers both with and without the air-entraining agent and two different cement contents were used. The type II and IIA cements (D and E) in the center plot show the same general trend, although the points are less closely grouped. In the case of the type III and IIIA cements, there were no significant differences in durability of the $4\frac{1}{2}$- and 6-sack mixes.

Summary

1. The three air-entraining agents Darex, N-Tair, and Vinsol Resin showed similar performance characteristics.
2. Under similar conditions there were no significant differences in the results obtained by adding the air-entraining agent at the mixer or by using an air-entraining cement in which the agent is interground.
3. Entrained air was effective in improving the freezing-and-thawing durability of concretes made with a wide variety of cements.
4. The relative improvement in durability was greatest for the concretes that had the poorest durability without air entrainment.
5. Generally air-entrained concrete had lower compressive and flexural strength than the companion plain concrete made with a given slump, cement content, and cement type. Since the decreases were usually much larger for the rich mixes, the greater need for careful control of the air content of rich mixes is strongly emphasized.
6. Freezing in air and thawing in water was not as severe as freezing and thawing in water.
7. The air content of the concrete at the start of freezing and thawing appeared to be the most important factor influencing durability.

Acknowledgments:

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A Simple Field Test For Consistency of Concrete*

by J. W. Kelly[1] and Norman E. Haavik[2]

SYNOPSIS

A simple field test for consistency of concrete is described, which consists in observing the penetration of a 30-lb. metal ball 6 in. in diameter into the surface. Through a coincidence, roughly the penetration equals half the slump. Similar penetration tests have recently been developed in England, Germany, and Spain. The results of laboratory and field tests are given; and the use, precision, and applicability of the test are discussed.

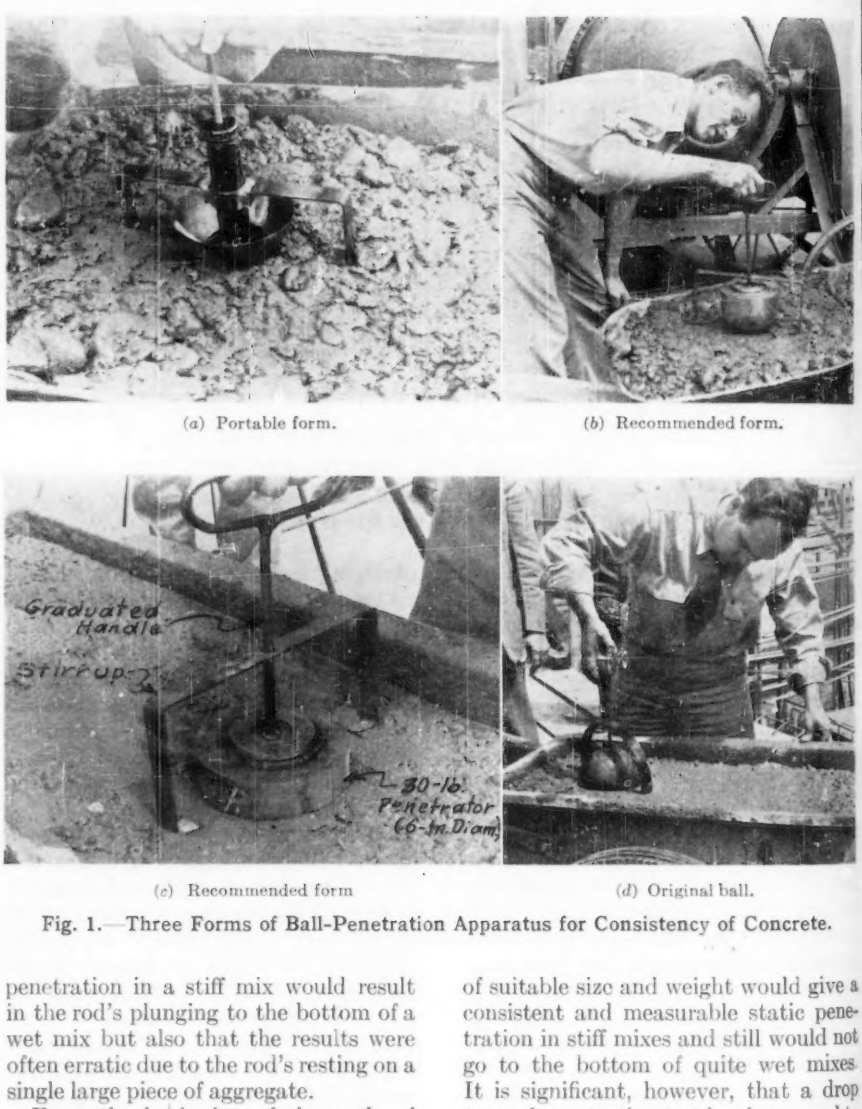
THE maxim that the best plans are the simplest applies with particular force to a field test for control of the placeability of concrete. In spite of the simplicity of the accepted slump test, the authors have long felt that it could be excelled through the use of a greater force than the weight of the concrete itself to produce a positive displacement of the mass. The results to date indicate that there are useful possibilities in a penetration type of test having sufficient power, and displacing a sufficient volume of concrete, that field conditions of placement are fairly well represented. Since many concrete technologists are interested in methods of field control of consistency, and since considerable further experience would be required to perfect the equipment and technique based on such a principle, it seems desirable to publish the results of the preliminary experiments and thus to encourage others to contribute to the development.

It must be clearly understood that the present discussion relates not to the complicated problem of *workability* with all its factors and nuances, but to the measurement of *consistency* or whatever property is measured by the slump test. In fact, the remarkably close correlation with the slump test is the chief justification for describing the ball-penetration test at this time. At least the ball test is quicker and easier to perform and can be made under certain conditions where the slump test is not applicable.

Prior work on penetration tests in this country has been done by Pearson and Hitchcock in 1923 (1)[3] and by Smith and Conahey in 1928 (2); one to three rods of relatively small diameter ($\frac{1}{2}$ to $\frac{3}{4}$ in.) were used. These tests have not received general acceptance. In static and impact tests with a $\frac{5}{8}$-in. rod, the authors have found not only that conditions producing a suitable penetration in a stiff mix would result in the rod's plunging to the bottom of a wet mix but also that the results were often erratic due to the rod's resting on a single large piece of aggregate.

From the beginning of the authors' investigations, metal balls have been tried in the belief that, under the constant force of the considerable weight of the ball, (1) the *area* of coverage would be great enough to integrate the resistance over several pieces of coarse aggregate, and (2) the *volume* of concrete displaced would increase so rapidly with depth of penetration that a single static test could be applied to both the stiffest and the wettest mixes that should be encountered in the range of plastic concrete.

Various techniques were tried, including a "drop-ball" test which could be easily made in the field (3); but the use of impact was found to be unnecessary when it was discovered that a ball of suitable size and weight would give a consistent and measurable static penetration in stiff mixes and still would not go to the bottom of quite wet mixes. It is significant, however, that a drop type of penetration test has been used to control pavement work in Germany (5).



(a) Portable form. (b) Recommended form.

(c) Recommended form (d) Original ball.

Fig. 1.—Three Forms of Ball-Penetration Apparatus for Consistency of Concrete.

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[3] The boldface numbers in parentheses refer to the list of references appended to this paper.

The Test

The test eventually adopted consists in observing the penetration of a 30-lb. plunger, having a 6-in. hemispherical tip, into the leveled-off surface of the concrete. The penetration in inches is read on the graduated handle of the plunger, at the top of a sliding stirrup with two feet, each 1 in. square, the centers of which feet rest on the concrete at a distance of $5\frac{1}{2}$ in. from the axis of the hemispherical tip. The penetration is read to tenths of an inch, usually as the average of three readings. The concrete may be in a container, in a wheelbarrow or cart, or in the forms, so long as the depth is at least 6 in. and the least horizontal dimension 12 in.

The original form of the device was a 6-in. cast-iron ball, Fig. 1 (*d*), and for convenience the test is still called a "ball test." A more economical form to manufacture is shown in Figs. 1 (*b*) and 1 (*c*); it was machined from a 6-in. steel cylinder, and the length of the cylindrical portion was made such that the plunger with handle weighs exactly 30 lb. Observations to date indicate no significant effect of the difference in shape (as between ball and cylinder) of the upper portion of the plunger, which comes into play only when the concrete is of wet consistency, with slump greater than about 6 in. In fact, the difference in shape in the fourth inch from the bottom (corresponding to 6- to 8-in. slump) is not very large (see Fig. 2 (*b*)). Mixes of slump greater than 8 in. should seldom if ever be manufactured; and in such cases the penetration would be reported as being greater than 4 in.

A portable form of the apparatus is shown in Fig. 1 (*a*). The plunger tip is a hemispherical steel bowl available from chemical supply firms as a "sand bath." The plunger is the barrel of an automobile tire pump, cut down in length Inside the barrel are two automobile valve springs, end to end. On the pump handle is machined a groove indicating when the hand-applied downward pressure (including the weight of the instrument) is 30 lb., as calibrated on an ordinary platform scale. The penetration scale is on the outside of the barrel. The pump base is ground circular to fit the bowl and is held in by spring clips which permit it to be disengaged and carried separately. The apparatus weighs only about 3 lb. and can be carried in an ordinary brief case. It is not so convenient to use as the dead-weight type, however, because the operator must simultaneously hold down on the handle and observe both the force mark and the penetration mark. Also, its use is limited to a penetration of 3 in.

The stirrup is merely a strap of $\frac{1}{8}$-

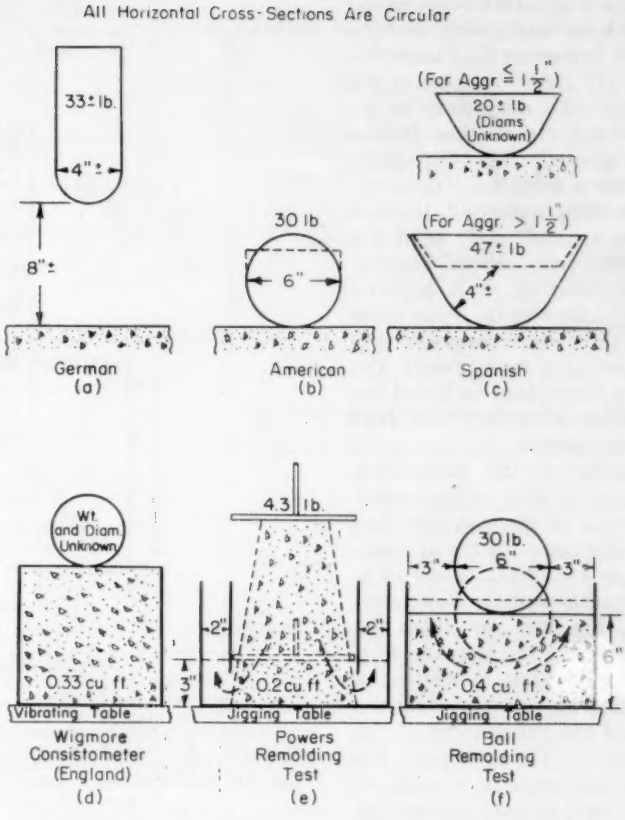

Fig. 2.—Static (a–c) and Dynamic (d–f) Penetration Tests.

by 1-in. steel, bent into any shape that will clear the plunger and having each end turned inward 1 in. to form a foot which rests on the concrete. The zero reading of the stirrup on the penetration scale can be easily checked by setting the instrument on a rigid level surface. The over-all dimension of 12 in. was chosen so as to employ a reference surface at a distance from the ball sufficient to avoid the "bulge " of displaced concrete, and yet to go inside a fairly confined space, say a container 12 in. in diameter. Thus the penetration is referred to the surface of the concrete at a distance of 5 to 6 in. from the center.

Other Penetration Tests

A similar type of test has been developed in other countries. The Spanish "Iribarren" apparatus sketched in Fig. 2(*c*) consists of a spherical tip 8 in. in diameter and weighing about 47 lb. (**4**); the top is flared, presumably to keep the plunger from sinking too deep into wet concretes. A smaller form of the same apparatus, weighing 20 lb. but with other dimensions unknown to the authors, is used for concretes containing aggregates of maximum size $1\frac{1}{2}$ in. or less. In Germany, it has been stated by Graf that the consistency of the no-slump concrete for the construction of the Autobahnen was regulated by means of a 33-lb. (15-kg.) cylinder having a 4-in. (10 cm.) diameter with a spherical end, dropped 8 in. (20 cm.) onto the surface; the penetration was $1\frac{1}{2}$ in. (4 cm.) to 3 in. (8 cm.) (**5**). This apparatus is sketched in Fig. 2(*a*). Although the authors' form of penetration test was initiated without knowledge of the two tests just described, it is significant that the diameter (6 in.) finally chosen as being most desirable for all-round use is intermediate between the German (4 in.) and the Spanish (8 in.).

A penetration test to determine the consistency of lubricating (cup) grease has been standardized as A.S.T.M. Method D 217–48.[4] With regard to concrete, the problem is somewhat different because of the large discrete pieces of aggregate, but it is believed that the principle is similar. Penetration tests are also used to some extent in soil mechanics, and penetration tests of metals are used as a measure of hardness. Seven penetration tests of concrete or mortar are listed in a paper by Powers (**6**); still another is the old "rubber-boot" penetration test—some specifications actually required that the workmen should not sink more than a stated depth in the freshly placed concrete!

[4] Standard Method of Test for Cone Penetration of Lubricating Grease (D 217 – 48), 1949 Book of A.S.T.M. Standards, Part 5, p. 816.

Although the original intention was to develop a test for workability as indicated by such devices as the Powers remolding test (7) the correlation of the static ball test with consistency as indicated by slump was so close that it could not be ignored. That is, regardless of the name or definition of the property which is being measured, the ball test measures approximately what the slump test measures. From observations to date, however, it is believed that such differences as do occur show the ball test to be more discriminating in that it indicates more nearly the placeability as determined by visual observation during laboratory and field handling of the concrete.

Further studies of the penetration type of test as applied to laboratory conditions are in progress at the University of California, with the arrangement shown in Fig. 2(*f*). The test is simply a modification of the Powers remolding test, Fig. 2(*e*), in which the same outer container and the same flow table are employed, but in which the 6-in. 30-lb. plunger is substituted for the inner shell and the flat plunger of the Powers apparatus. The principle is the same, in that the concrete is made to flow outward and upward around an obstruction of fixed shape—the ball in Fig. 2(*f*). The chief difference is that the driving force of the ball is far greater and is constant for each jig, whereas the driving force of the Powers test (4.3-lb. plunger plus weight of concrete) decreases with each jig until for very stiff mixes the required number of jigs runs into the hundreds. Further, the ball test can be used with aggregate of greater maximum size. It is again significant that in England a similar test has been developed recently (8); this device, called the Wigmore consistometer, is sketched in Fig. 2(*d*) from the incomplete information available. The authors' studies of the jig type of ball test are quite limited, but it is reasonable to expect that whatever property is measured by the Powers remolding test is likewise measured more quickly and positively by the ball type of remolding test; and there is an advantage in the applicability to larger aggregates. The present paper, however, is confined to a discussion of the static ball test as a simple field test for consistency.

Test Results

Figure 3(*a*) affords comparison of ball penetration and slump, as determined in 1943 by Misener, under the supervision of one of the authors. The scales are such that 1 in. of penetration equals 2 in. of slump. The ratio of 1 to 2 is close, except that for the stiffer mixes the penetration is somewhat more than half the slump. This difference is characteristic; in part it is probably due to initial penetration of a screeded-up surface layer of mortar, but in part it is believed to be due to greater sensitivity of the ball test at these stiff consistencies. Of course, in any comparison with the slump test it must be borne in mind that the slump test itself is often erratic. For most practical purposes a 1:2 ratio can be used to convert penetration to slump, and *vice versa*.

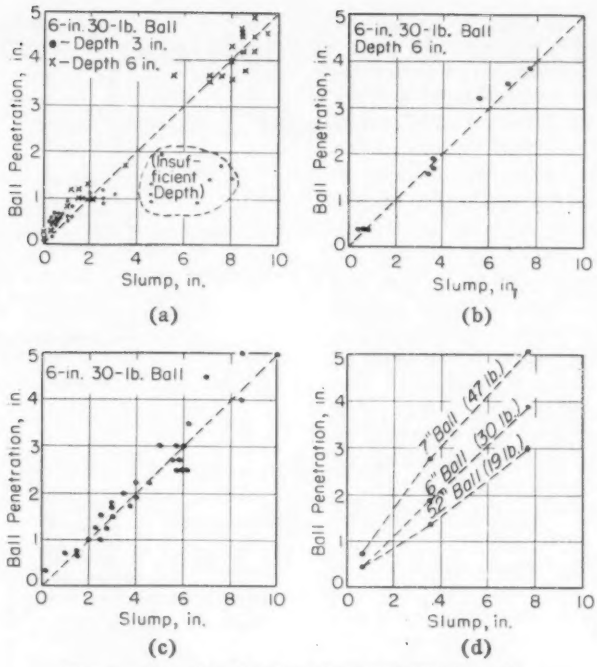

Fig. 3.—Results of Laboratory and Field Tests.

(*a*) Laboratory tests by Clifford A. Misener, 1943. Maximum size aggregate ¾ in. Cement factor 6, 7, and 8 sacks per cu. yd. W/C 5, 6, and 7 gal. per sack. Per cent sand 36, 38, 40, 42.
(*b*) Laboratory tests by authors, 1949. Maximum size aggregate 1½ in. Cement factor 4.7, 5.3 sacks per cu. yd. W/C 5.3 to 8.8 gal. per sack. Per cent sand 35, 40.
(*c*) Field tests by E. L. Howard, 1949. Variety of aggregates and mixes.
(*d*) Effect of size of ball. (Laboratory tests by authors.)

The results for batches of intermediate consistency are shown in Fig. 3(*a*), even though they are rejected because of insufficient depth of material. In these tests only 0.2 cu. ft. of concrete was used, which filled the container 12 in. in diameter to a depth of only 3 in.; and particle interference occurred. This effect was not discovered in time to replace the batches of this series with deeper batches such as those used in subsequent tests.

In Fig. 3(*b*) are results of recent laboratory tests by the authors, which again show very nearly a 2:1 ratio of slump to penetration of a 6-in. 30-lb. ball. The same data are plotted in Fig. 3(*d*) together with test results for a 5.2-in. 19-lb. ball and a 7-in. 47-lb. ball. For each size of ball there is a consistent relation between slump and penetration; it is only a coincidence that the 6-in. 30-lb. ball exhibits the approximate 2:1 relationship.

Recently E. L. Howard and his associates in Pacific Coast Aggregates became interested in the ball test, and have used it on hundreds of truckloads of ready-mixed concrete. They are still engaged in an extensive study of proportions and workability of the various mixes made at their several plants with a number of different aggregates; and wherever a slump test is made a ball test is made also. The relation between slump and flow is typified by Fig. 4(*c*) by data furnished by Mr. Howard; again it is nearly 2:1. As this ratio became established, for many other batches the slump test was omitted because it was relatively cumbersome; only the ball test was used. The possibility of carrying a test ball on each truck has been suggested as an aid to determining consistency of *each load* quickly at the job and thus maintaining uniform control; only borderline cases would require the specified slump test.

An interesting application of these studies to paving work was made by testing the concrete in place, at various stages of finishing. First the customary test was made on the fresh concrete as dumped on the subgrade; the penetration was 1.0 in., which corresponds to a slump of 2 in. Behind the spreader the penetration was 0.2 in. less, indicating a reduction of about ½ in. in slump. Behind the first finisher, which brought up some surface mortar, the penetration (and corresponding slump) were the same as in the original pile on the subgrade. There are many other situations where similar studies would be of value in detecting segregation or changes in

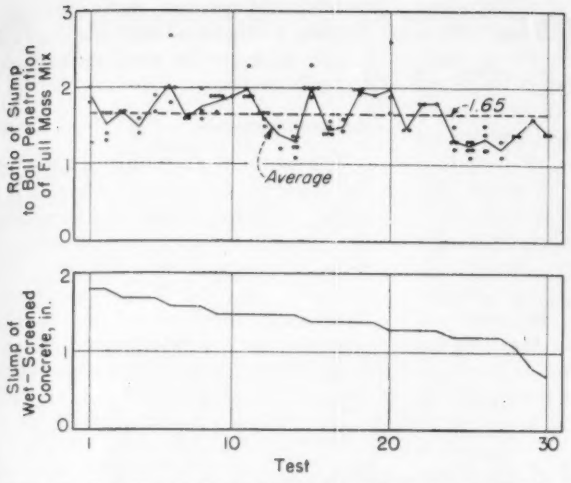

Fig. 4.—Results of Control Tests on Mass-Concrete Mix.

Laboratory tests by M. Polivka and associates, 1949. Maximum size aggregate 2½ in. Cement factor 2.5 to 3.7 sacks per cu. yd. W/C 5.6 to 9.7 gal. per sack. Per cent sand 23 to 26. Per cent air 1.5 to 7.0.

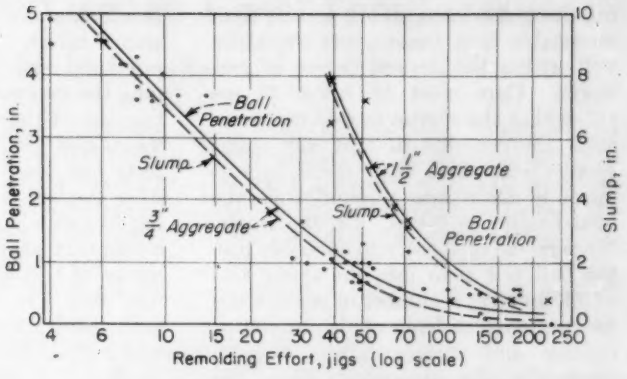

Fig. 5.—Penetration and Remolding Effort.

Tests by Misener (left) and authors (right).

consistency of concrete at various stages of casting; for example, in the receiving hoppers at plant and job. The use of the ball test would be advantageous for such studies, not only because of its speed but also because the concrete can be tested *in place*, after it is in the forms or on the subgrade, without removing a sample. The test can even be made in a mixer, at various locations and at various stages of mixing.

Another application of the ball test, in this case to air-entrained mass concrete, has been made by Milos Polivka and associates at the University of California. The concrete contained aggregate of 2½-in. maximum size, and the mixes were of the lean and harsh nature employed in concrete for dam construction, as shown in Figs. 1(*a*) and 1(*b*). The concrete had to be wet-screened to 1½ in. for slump tests. Since a measure of the consistency of each batch was desired, and since the wet-screening and slump test were cumbersome and wasteful of material, the slump test was made on only the first batch of each run of several batches; thereafter the ball test only was employed. The results are shown in Fig. 4, in the form of the ratio of slump of wet-screened concrete to ball penetration in the full mass mix. The average ratio was 1.65, and the variation from batch to batch was reasonably uniform, considering that it was caused not only by the errors in testing but also by the unavoidable variations in the batches themselves.

Although the penetration test is considered herein as a *consistency* test only, comparison with remolding effort is of interest. For the test series of Figs. 3(*a*) and 3(*b*), respectively, in Fig. 5 the remolding effort is plotted to a logarithmic scale against the penetration to natural scale. For comparison, the corresponding average slump is also shown as a dash line; but the plotted points are for penetration only. It is seen that the correlation is not too close, as would be expected, but that there is a rough general relation between penetration and remolding effort of about the same order as that between slump and remolding effort.

It will be noted in Fig. 5 that the curves for 1½-in. aggregate lie considerably to the right of those for ¾-in. aggregate. The difference may be largely due to some characteristic of the remolding test itself; at least it is reasonable to suppose that relatively more remolding effort would be required to work concrete of a given consistency, but containing the larger (1½-in.) aggregate, around the corner and into the narrow 2-in. space of the mold; see Fig. 2(*e*).

Use and Application of the Test

Sampling and Testing:

The "sample" of concrete is a relatively small volume at and surrounding the point of penetration. The size of the sample is effectively increased, and the representation of the entire batch or mass increased, by making three penetration observations as recommended for each test. Whereas samples for a slump test must be removed from the mass and rehandled in order to fill the mold, samples for the ball test are *in place* within some mass of concrete.

In general, the recommended minimum horizontal dimension of the concrete under test is 12 in., in order to avoid edge effects. In a long narrow container such as a wall form, the minimum horizontal dimension might well be as small as 8 in.

The minimum original depth of concrete for a satisfactory test depends both on the depth of penetration and on the maximum size of aggregate. The minimum clearance under the ball after penetration should be perhaps twice the maximum size of aggregate. Thus a 6-in. original depth would be sufficient for a concrete containing 1½-in. aggregate and having a penetration of 3 in. (slump 6 in.) and would likewise be sufficient for a paving mix containing 2½-in. aggregate and having a penetration of 1 in. (slump 2 in.).

If both of the foregoing limits are applied, the minimum sample of concrete which would be employed in a cylindrical container would be 0.4 cu. ft., or about 60 lb. This is twice as much as would be required for a slump test. However, in practice usually the concrete will be in even greater amount, as in a hopper, wheelbarrow, cart, or form.

Admittedly the ball test does not measure lack of cohesiveness, or tendency to segregate, to the same extent as the slump or flow tests, in which the concrete may scatter; but neither does the test for remolding effort. The ball test does respond to harshness in the form of particle interference. Inspection of the concrete after removal of the ball gives some visual indication of workability—in fact the displacing action of the ball is somewhat similar to the common practical test of drawing a shovel heavily across the surface of concrete.

Errors and Precision:

No difficulty should be encountered in producing a ball of the correct size, shape, and weight and with a reasonably smooth surface finish. No significant errors of test, or differences as between apparatus used by different organizations, should occur from these sources. The apparatus is easily kept clean and free from caked mortar.

Personal errors might arise from differences in setting the ball on the con-

crete, taking the initial reading, or reading the penetration on the scale. With reasonable care, these errors should be well within the desired degree of precision. Care must be taken to see either that the stirrup feet do not penetrate the concrete or that any slight penetration which may occur in soft mixes is taken into account when the final reading is taken. On the whole, the personal factor should enter less into the ball test than into the slump test which involves a number of possibilities for personal differences in sampling, rigidity and surface finish of base, dampening the apparatus, filling the mold, rodding, raising the cone, freedom from jarring, and selection of point to which the slump is measured.

The penetration is read by estimation to 0.1 in., which corresponds to less than $\frac{1}{4}$ in. of slump. This precision is sufficient for field work; in fact, the slump itself is seldom considered accurate within $\frac{1}{2}$ in. When three readings of penetration are averaged, as recommended, the reproducibility is easily within 0.1 in. This averaging is done mentally; only the average is recorded. Averaging of three readings also permits rejection of any individual reading which differs greatly from the other two because of the ball's being located either over a large stone or in a soft mortar spot. So far, such erratic readings have been infrequent. In order to increase the precision of reading at low penetrations, the diameter of smear might be measured and converted to vertical penetration; but the authors consider this refinement unnecessary for the purposes of the field test.

The amount of screeding to level off an area for test should be a minimum; otherwise a layer of mortar might be worked to the surface and result in an initial penetration before the real concrete mix is encountered by the ball. Again, error from this source can easily be kept within the least reading of the instrument.

Applicability:

The present application of the ball penetration test is limited to the range of plastic concretes, but it would seem reasonable that the consistency of no-slump mixes, even those for precast products, could be controlled by dropping the ball some fixed distance, as in the case of the German test previously mentioned (5). A series of drop-ball tests has been made by Misener (3). Also, the test can be made remote-reading, by extending the handle rod through a long tube attached to the stirrup. By means of this arrangement, in a ready-mix plant the test could be made on each batch of concrete in the hopper, which is considerably below the operating floor. At the job the test could be made in a deep wall form, on the concrete in place.

Further tests with the ball apparatus are either being made or are planned for the near future, on air-entrained concretes and lightweight concretes. Whereas in the slump test the driving force depends on the weight of the concrete itself, in the ball test the driving force is constant and is perhaps more nearly representative of the actual work required to place and compact the concrete. Mr. Howard informs us that the ball test appears to reflect differences in workability of air-entrained concretes as observed during placement, whereas the slump test is relatively insensitive to such differences.

Concluding Remarks

The static ball-penetration test described herein appears to offer important possibilities in the practical measurement and uniform control of consistency of concrete. Although it has some limitations, it is free from certain deficiencies of the slump test, it is at least equally precise, and it is more rapid and convenient to perform. It can be made on "undisturbed samples" of the concrete in place or at various stages of the manufacturing process.

In the interest of improved control of consistency, it is urged that concrete technicians try out the ball test in comparison with the slump test, and communicate their findings.

Extension of the penetration principle to jigging and drop-ball types of test should permit measurements of greater refinement and over a wider range; and further work is being done along these lines.

Acknowledgments:

The authors gratefully acknowledge the cooperation of those whose test results are cited in the paper. In addition, Mr. Gordon F. Lammiman conducted a series of tests as a thesis project in 1942; and Mr. E. L. Whittier, Principal Laboratory Mechanician in the Engineering Materials Laboratory, has given valuable suggestions on the mechanical design of the apparatus.

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A Reduction-of-Area Gage for Use at Low Temperatures

By G. W. Geil[1] and N. L. Carwile[1]

During the course of an investigation of the mechanical properties of metals at low and moderately elevated temperatures, it became evident that an instrument was needed which could be used to measure accurately the change in diameter of cylindrical specimens submerged in liquid baths during tension tests at various temperatures. The portion of the true stress - true strain curve from maximum load to fracture cannot be determined from extension measurements. Moreover, for some metals, an accurate determination of the curve from yield to maximum load cannot be made from extension measurements as the metal may contract locally before reaching the maximum load. Simultaneous load and diameter measurements are essential for the determination of the complete true stress - true strain curves for metals in tension as pointed out by MacGregor.[2]

Ordinary reduction of area gages cannot be used satisfactorily on specimens submerged in liquid baths. The photographic method described by Seigle[3] for determining the change in diameter of a specimen submerged in a liquid bath during a tension test at low temperature was unsatisfactory at temperatures below −130 C. The reported accuracy of 0.0007 in. from the photographs obtained under the most favorable conditions is considered inadequate. It was deemed advisable to design a mechanical gage suitable for use in the temperature range of −196 C. to +100 C.

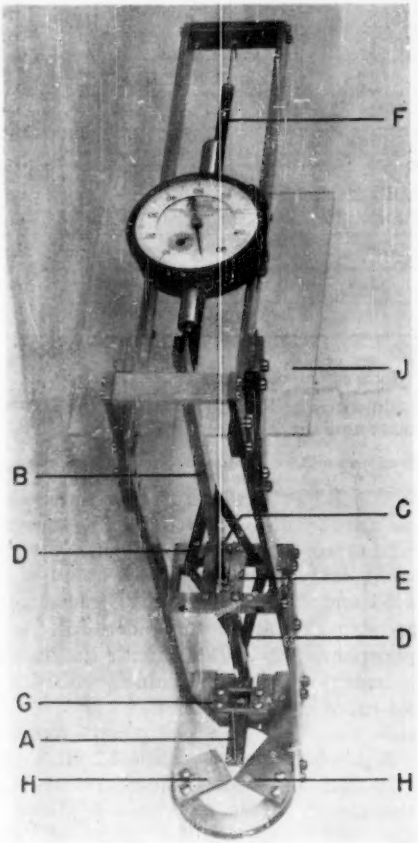

Fig. 1.—Photograph of Reduction of Area Gage.

Part	Material	Remarks
A.....sliding anvil	S.A.E. 52100	hardness of Rc 63
B.....lever	A.I.S.I. 440-C	hardness of Rc 55
C.....pivot	A.I.S.I. 440-C	hardness of Rc 55
D.....flexure strips	phosphor bronze	cold rolled 0.003-in. sheet
E.....guide bars	monel	cold rolled
F.....tension spring	phosphor bronze	cold drawn
G.....retainer caps	monel	cold rolled
H.....fixed anvils	S.A.E. 52100	hardness of Rc 63
J.....shield	Lucite	

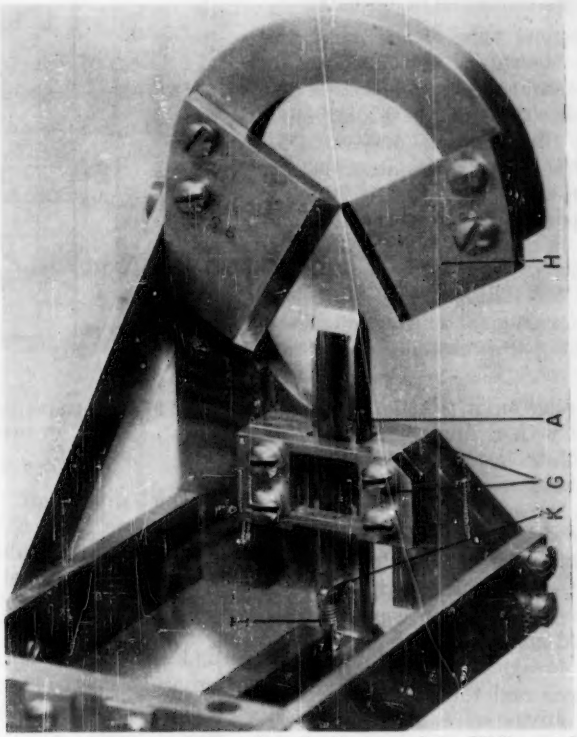

Fig. 2—Photograph Showing the Design of the Sliding and Fixed Anvils of the Reduction of Area Gage.

Part	Material	Remarks
A.....sliding anvil	S.A.E. 52100	hardness of Rc 63
H.....fixed anvils	S.A.E. 52100	hardness of Rc 63
G.....retainer caps	monel	cold rolled
I.....tension spring	phosphor bronze	cold drawn
K.....anchor pin	monel	cold rolled

Design of the Gage:

A photograph of the reduction of area gage is shown in Fig. 1. The change in diameter of the test specimen during a tension test is followed by the movement of the sliding anvil *A* which is held against the specimen with slight pressure exerted by the tension spring *F*. The movement of this anvil is transmitted to the spindle of the dial indicator by means of the simple lever *B*. The pivot or fulcrum of this lever is a knife-edge located at position *C* (not visible in Fig. 1). To maintain the lever in position, it is supported by the four flexure strips *D*. These thin strips are sufficiently flexible to permit rotation of the lever about the knife-edge through an angle consider-

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[1] National Bureau of Standards, Washington, D. C.

[2] C. W. MacGregor, *Proceedings*, Am. Soc. Testing Mats., Vol. 40, p. 508 (1940).

[3] L. Seigle, "Effect of Ferritic Grain Size on the True Stress-Strain Tensile Properties and Notched Impact Strength of Ingot Iron at Low Temperatures," a thesis presented to the Graduate School, University of Pennsylvania, 1948.

ably greater than that required to follow the change in diameter of the test specimen. The two guide bars *E* are adjusted to give a clearance of 0.01 in. to the lever *B* and serve to hold the lever in position and prevent any excessive twisting of the flexure strips while the instrument is not in use. A lubricated bearing such as roller or ball bearings or a sleeve type bearing could not be used as the fulcrum for the lever as this portion of the instrument is submerged in the temperature-controlled liquid bath.

An enlarged view of the measuring anvils is shown in Fig. 2. The six ribs (two each on top and bottom and one on each side) on the sliding anvil serve as the bearing surfaces. To minimize the area of contact of the bearing surfaces, the ribs of the retainer caps *G* are at right angles to the direction of movement of the anvil *A*. A clearance of 0.002 in. between these caps and the sliding anvil is sufficient to allow for unequal contraction of the component parts on cooling to low temperatures.

The sliding anvil is attached to the lever arm with a small tension spring *I* to facilitate installation of the gage on the tension specimen while immersed in the liquid bath. The anchor pin *K* for this spring also serves as a stop against the retainer caps *G* to prevent the measuring edge of the sliding anvil hitting the contact edges of the fixed anvils *H*, when the tension specimen breaks. Both ends of the sliding anvil and the contact ends of the fixed anvils were machined to a dihedral angle of 50 deg. and a radius of 0.02 in. This design provides for the free access of the measuring contact edges of the anvils to the minimum diameter portion of the necked section of the tension specimen.

The contact edges of the anvils are coplanar and at an angle of 60 deg. to each other. With this arrangement, the movement of the sliding anvil is 1.5 times the change in diameter of the test specimen. The length of the lever arm between the pivot knife-edge and the anvil knife-edge is approximately 2.5 inches; the length of the lever arm between the pivot knife-edge and the contact point of the dial indicator is approximately 5 inches. Thus the total magnification of the instrument is approximately 3, or actually 2.985, by calibration.

The dial indicator is a jeweled low-friction type indicator and is mounted on the framework so that it is adjustable. The choice of the dial indicator depends upon the ductility of the metal to be tested. If the ductility is very low a dial indicator with a small range of approximately 0.25 inch and dial divisions to 0.0001 inch can be used. If the metal to be tested has high ductility, a dial indicator with a range of approximately 1 inch is required in order to follow the larger change in diameter of the specimen.

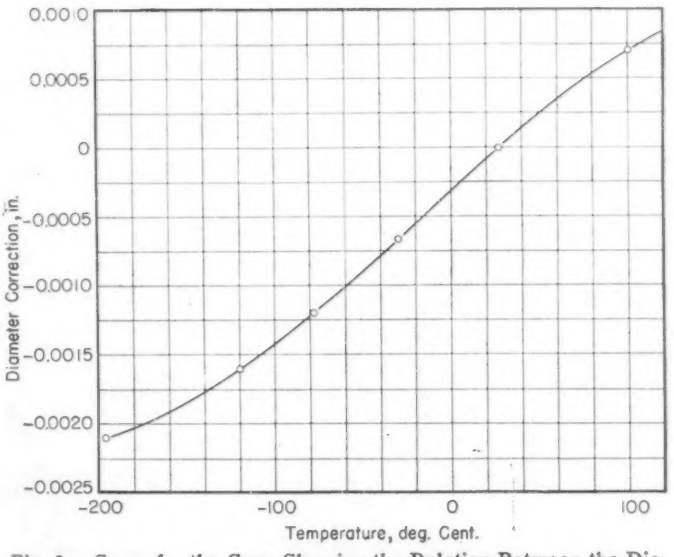

Fig. 3.—Curve for the Gage Showing the Relation Between the Diameter Corrections and the Temperature.

The dial reading corrections are 2.985 times the diameter correction.

The anvils are made of S.A.E. 52100 steel and the lever and pivot knife-edge are made of A.I.S.I. type 440C stainless steel, heat-treated for hardness values of Rockwell C63 and C55, respectively. The flexure strips and the tension springs are phosphor bronze. The framework of the instrument is constructed of cold-rolled monel metal, which has suitable corrosion resistance and strength. A plastic shield *J* is used to insulate the dial indicator from the vapors of the temperature-controlled liquid baths, and it also serves as a convenient handle for manipulation of the instrument.

Calibration of the Gage:

The gage was calibrated at room temperature to check the linearity of the dial readings with diameters. A series of six cylindrical test standards, each machined with a circumferential groove of 0.03 in. radius, were measured with an optical comparator to an accuracy of 0.0001 in. The diameters of the standards ranged from 0.1484 in. to 0.4864 in. The dial readings, obtained with the test standards, were plotted against the diameters of the test standards and a linear relationship was obtained throughout the entire range. The slope of this line is equal to the magnification factor of the instrument and, as mentioned previously, is 2.985. The zero reading of the instrument, R_0, is obtained by determining the dial reading at the intercept of this straight line with the zero diameter axis of the graph. The actual diameter, measurement *D*, for any reading is given by the following equation:

$$D = \frac{R_0 - R}{F}$$

in which R_0 represents the zero reading, *R* the actual dial reading, and *F* the magnification factor for the instrument. The diameters obtained from the dial readings of this gage on the test standards were identical, to the nearest 0.0001 in., with the diameter measurements obtained with the optical comparator.

The instrument was also calibrated under simulated test conditions to obtain the temperature correction curve. Test standards of fused quartz were used. The standard was placed in position in the gage and the diameter reading obtained at room temperature. The gage and specimen then were placed in the temperature-controlled liquid bath and submerged to the depth at which the gage is used during a tension test. Diameter readings were taken after temperature equilibrium was attained. The time to reach temperature equilibrium ranged from 10 min. to 15 min., and observations for greater periods up to 1 hr. showed no further changes in the diameter readings. Calibration tests were made at +100 C., +27 C., −78 C., −120 C., and −196 C. Because of the very small coefficient of thermal expansion of fused quartz, the change in diameter of the quartz test standard did not exceed 0.00003 in. Therefore, the changes in the dial readings were attributed to dimensional changes in the instrument. Data showing the relation between temperature and the indicated correc-

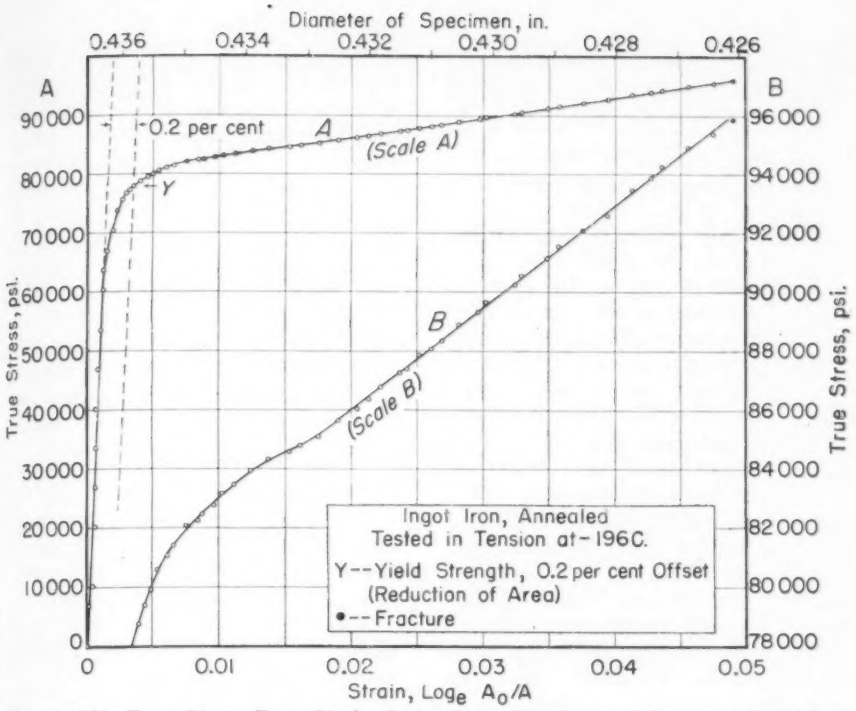

Fig. 4.—The True Stress-True Strain Curve for a Specimen of Annealed Ingot Iron Tested in Tension at −196.

Curve *A* = the complete true stress-true strain curve. Curve *B* = the portion of the true stress-true strain curve from yield to fracture on a more open stress scale.

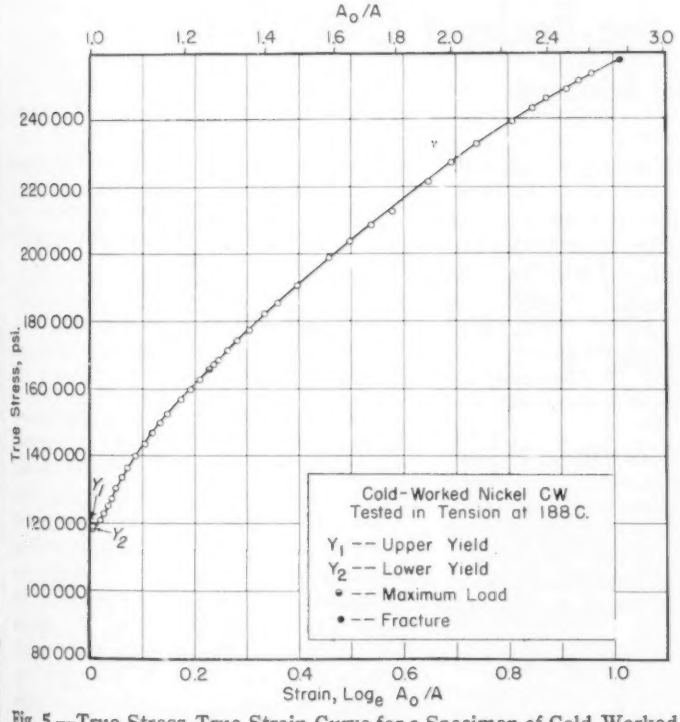

Fig. 5.—True Stress-True Strain Curve for a Specimen of Cold-Worked Nickel Tested in Tension at −188 C.

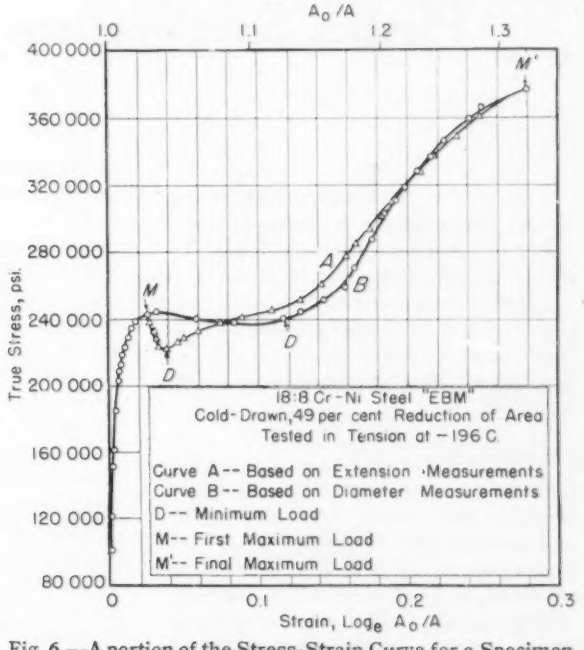

Fig. 6.—A portion of the Stress-Strain Curve for a Specimen of Cold-Drawn 18:8 Chromium-Nickel Steel Tested in Tension at −196 C.

tion to be applied to the diameter measurement are shown in Fig. 3. The change in the observed dial readings are 2.985 times the correction (actual diameter values) shown in this figure.

Applications of the Gage:

The manipulation of this gage to determine the change in diameter of an unnotched cylindrical specimen during a tension test at low or moderately elevated temperatures is very simple. The test specimen supported vertically between the adapters of the tension testing machine is completely submerged in the temperature-controlled liquid bath. The gage is placed in position on the specimen with the measuring anvils at any position along the gage length of the specimen, and a time interval of about 15 min. is allowed for the gage to come to temperature equilibrium. The alignment of the gage with respect to the specimen is adjusted until a minimum diameter reading is obtained, indicating that the plane of the measuring anvils is perpendicular to the axis of the specimen. While maintaining this alignment, the gage, supported by hand, is moved up and down through the gage length of the test specimen to find the diameter at the area of minimum cross-section. Numerous simultaneous load and diameter readings are made during the tension test.

This gage also can be used for following the change in diameter of circumferentially notched cylindrical specimens during test in tension at low or moderately elevated temperatures. For this purpose a set of anvils is required in which the measuring edges are machined to an angle less than the smallest notch angle of the test specimens. The radius of the measuring edges of the anvils likewise must be less than the smallest radius at the root of the notch.

An example of the use of this gage in following the change in diameter of a metal specimen which has very little ductility at low temperature is illustrated in Fig. 4. This figure summarizes the results obtained in a tension test at −196 C. with a cylindrical tension specimen of annealed ingot iron. The true stress is plotted against the true strain. The true stress is the current load divided by the current minimum cross-sectional area and the true strain is the log$_e$ A_0/A in which A_0 and A represent the initial and

current minimum cross-sectional areas, respectively. Curve *A* is the entire true stress - true strain curve for this specimen. The portion of curve *A* extending from yield to fracture is replotted on an expanded stress scale as curve *B*. The maximum deviation of any point from the curve corresponds to a change in diameter of the specimen of less than 0.0001 in. The bulge in the lower portion of curve *B* is connected with a tendency to a drop of beam at yielding for the initially annealed ingot iron at this temperature.

An example of a complete true stress - true strain curve obtainable by the use of this instrument in a tension test in which the metal retains high ductility at low temperatures and contracts locally after reaching the maximum load is illustrated in Fig. 5. This figure shows the results obtained in a tension test at −188 C. with a cylindrical test specimen of nickel (99.4 per cent Ni) which had received prior cold working by extending in tension to a 25 per cent reduction of area.

The determination of true stress - true strain curves in cases where local contraction occurs before the load reaches a final maximum value is also possible by the use of this instrument, as illustrated by the results given in Fig. 6. Portions of the curves from the points representing initial yielding to the final maximum load, as obtained by two different types of measurements during a tension test with a cold-worked 18:8 chromium-nickel steel at −196 C., are shown in this figure. Curve *A* is based upon measurements of the extension of the specimen during the test as obtained from the automatic load-extension chart and on the assumption that the specimen remains cylindrical (no local contraction) with deformation to the final maximum load, represented by the point *M'*. The actual true stress - true strain curve determined from the change in diameter of the same specimen during the tension test as measured with this gage is shown as curve *B*. Curve *B* shows that the local contraction at the minimum load, represented by point *D* (true strain of approximately 0.12) corresponds to an actual reduction of area of approximately 11 per cent, whereas the curve *A*, based on extension measurements, indicates an apparent true strain of about 0.04, corresponding to a reduction of area of approximately 4 per cent. Thus curves *A* and *B* are not quantitatively similar.

Acknowledgment:

The authors gratefully acknowledge the assistance of Mrs. F. A. Wilkinson and Miss L. B. Weinrich in the experimental testing and the preparation of illustrations, and the assistance of Mr. H. S. Miller of the Shop Division in the construction of the gage.

Plastics Specifications in the Federal Government[1, *]

By Gerald Reinsmith[2]

THE amount of time, money, and effort being spent on some phase of specifications for plastics—by groups, individuals, and companies such as plastics materials producers and consumers—and by organizations such as the P.M.M.A., A.S.T.M., S.P.E., S.P.I., and various Government agencies, is tremendous.

Philosophy and Types:

Several papers have been published covering the theory, use, philosophy, and preparation of specifications, both in general (**1**, **3**)[3] and for specific materials (**2**, **4**, **5**). I should like to review briefly some of the more important points relative to the preparation of specifications, their theory, use, and philosophy, especially as applicable to specifications for plastic materials.

In general, specifications for any material are written primarily for two purposes, namely, for control of the product offered or for procurement. Control specifications may be divided into two types: those written for sales purposes and those written for manufacturing controls, with the latter being either derived from sales specifications or set by that uniformity in the material which the production department will guarantee (**1**).

The procurement or referee specification which serves as a basis for agreement between producer and consumer is considered the biggest problem in writing specifications. While the primary use of this type of specification is to convey from the purchaser or user to the contractor or manufacturer sufficient information as to what is required so as to enable the contractor or manufacturer to produce material which will be suitable for the use intended, there are other uses for this specification to which consideration should be given (**1**). Some of these uses are as follows:

(*a*) To aid engineers and designers in selecting suitable materials.
(*b*) To promote standardization and simplification.
(*c*) To provide basis for planning raw materials supply.
(*d*) To aid in conservation and proper use of critical materials.
(*e*) To provide brief but definite instructions to inspectors.
(*f*) To provide engineering data to serve as an aid in effecting technical conversions.
(*g*) To provide information in development work concerning similar products and what will have to be met in order to produce and sell competitively.

There are three generally accepted methods for writing the procurement specification. The ideal method would be to base the requirements entirely upon performance giving desirable characteristics of the material and providing accurate short-time tests for their determination. Another method is to base the requirements entirely upon composition. The third and most widely used method is to base the requirements upon a combination of performance and composition (**1**).

Preparation:

In providing adequate supply of materials for use during the recent World War, attention was focused on all our resources including productive capacity, man power, distribution, transportation, and raw materials. This need for an adequate supply which could be provided both economically and efficiently emphasized the urgency of

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[1] The opinions or assertions contained herein are the author's and are not to be construed as official or reflecting the views of the Army Ordnance Department.

* Presented before the SPI Plastics Seminar, Washington, D. C., November 15, 1949.

[2] Materials Engineer, Office, Chief of Ordnance, Department of the Army, Washington, D. C.

[3] Numbers in parenthesis refer to references listed at end of paper.

greater standardization of items purchased and more uniform and generally used specifications (6).

Because of this urgent situation and the current state of our knowledge, it is general practice to prepare plastic specifications based on a type of plastic material to which are added specific performance requirements. In other words, what is considered necessary to do a job is defined as briefly and concisely as possible in simple and measurable terms, with standard methods of test specified when available and information provided as to disposition of material in case of failure to comply with the requirements as well as a basis for adequate inspection.

Responsibility for Preparation:

At the present time, activities relative to the preparation of plastics specifications in the Federal Government come under the jurisdiction of two groups, namely, the Federal Specifications Board and the Munitions Board Standards Agency.

The Federal Specifications Board as presently constituted was established on August 9, 1945 (6). The Board is composed of representatives from the Treasury, Post Office, Navy, Interior, Agriculture, Army, Air Force, and Commerce Departments, and Veterans Administration, Federal Security and Federal Works agencies. In accordance with definite rules of procedure as approved by the Director on October 16, 1945, seventy-eight Technical Committees consisting of 700 engineers and technicians holding memberships from all agencies of the Government, develop Federal specifications under the direction of the Board. Specifications as prepared by the Technical Committee are published in a form $7\frac{7}{8}$ in. by $10\frac{1}{4}$ in. with 10-point type and 2-column text. To assist the Board, there is an Industry Advisory Council as established in April, 1946.

The Munitions Board Standards Agency as presently constituted was originally established on May 11, 1948. The Agency is composed of an Executive Group and an Agency Staff. The Executive Group consists of three full-time military members, one from each of the three military departments. The Agency Staff consists of such civilian and military personnel as required to carry out the standards program.

Interim Specifications:

Both the Federal Specifications Board and the Munitions Board Standards Agency have recognized that, in the process of eliminating tentative and department specifications, some procedure would be required which would permit the rapid processing and issuing of a specification that would be impossible under the established formal procedure. Accordingly, the Federal Specifications Board, to facilitate the use of a Federal specification while it is still in the "proposed" stage but has gone through the Industry-comment stage and is being sent to Government departments for comment, has established a procedure whereby a proposed Federal specification, on recommendation of the Technical Committee, can be promulgated as an "interim" purchase specification. To identify and differentiate "interim" purchase specifications from Federal specifications, they are published as Bureau of Federal Supply specifications and numbered in a "2000" series for immediate recognition. Upon the promulgation of the corresponding Federal specification, the "2000" series Bureau of Federal Supply specification is cancelled (6).

In a similar manner the Munitions Board Standards Agency has established a series of specifications known as uncoordinated specifications to be used by one activity to get immediate procurement needs for a period no longer than 6 months. The specification will bear the same number as though it had been coordinated except that a suffix identifying the activity issuing the specification will follow the number.

Standardization Work:

To provide some idea as to the work involved in the current standardization program, the following numbers of specifications were available in various Government agencies as of June 1, 1949 (6):

Air Force	2847
Army-Navy Aeronautical	842
Army	5899
Navy	1370
National Military Establishment	846
Army Tentatives	2915
Navy Ad Interims	2262
Federal	2001
Bureau of Federal Supply	400
Commercial Standards	159
Simplified Practice Recommendations	237

The above tabulation does not include standards published under authority of law by certain of the departments such as Agriculture, covering foodstuffs and agricultural commodities, and other miscellaneous specifications.

There is on the agendas of the Federal Specifications Board Technical Committees a specification workload of some 1350 projects which, when completed, will eliminate and replace many of the departmental specifications numbered above. However, it is estimated this workload represents seven years of work (6).

Federal Specifications Board Activities:

The Federal Specifications Board Technical Committee on Plastics has completed preparation of the following Federal Specifications:

L-P-344, Plastics; Cellulose Acetate, Molded.
L-P-349, Plastics; Cellulose Acetate Butyrate; Molded.
L-P-365, Plastics; Cellulose Nitrate (Pyroxylin) Sheets, Rods, and Tubes.
L-P-46, Plastics, Polystyrene, Molded.
L-P-490, Plastics; Polyvinyl Chloride-Acetate, Molded.
L-P-501, Plastics; Polyvinylidene Chloride (Saran), Molded.
L-P-406a, Plastics, Organic; General Specifications, Test Methods.
Amendment 1, April 15, 1949

The committee has in process of preparation the following proposed Federal Specifications:

Screen; Plastic.
Plastics; Phenolic, Molded.
Plastics; Methyl Methacrylate, Cast, Sheets, Rods, and Tubes.
Plastics; Melamine, Molded.
Plastics; Urea, Molded.
Plastics; Vinyl Chloride-Acetate, Sheets.
Plastics; Cellulose Acetate, Sheets.
Plastics; Ethyl Cellulose, Molded.
Plastics; Methyl Methacrylate, Molded.
Table Tops; Laminated Plastic.

Specification L-P-406a is also being worked on by the Committee to prepare a "b" (or second) revision which will be a compilation of the present Federal, Joint Army-Navy, Navy, A.E.S.A., and other Government test methods. This action will place all of the currently used Government test methods in one document, thus affecting a saving as well as simplifying the material specifications by eliminating the lengthy test sections.

Following completion of this action a "c" revision will be immediately worked on to reduce the number of methods through elimination of duplicate procedures and to improve technical adequacy of the methods.

Munitions Board Standards Agency Activities:

Under the Munitions Board Standards Agency, the current Joint Army-Navy specifications covering thermosetting plastics materials or the series of specifications known as JAN are being reviewed with the general objectives of:

1. Reducing qualification testing required at Government laboratories through:
   (*a*) Eliminating the requirement, or
   (*b*) Permitting qualification by the

manufacturer either in his own or some other laboratory as may be agreed upon, or

(c) Requiring only qualification of the manufacturer of the material in the case of molded plastics.

2. Increasing emphasis on inspection.

3. Adding new materials or data as available and as suitability of the material can be determined.

4. Making desirable changes in currently specified data as required or warranted.

Military specifications covering molded thermoplastic materials are being prepared as follows:

Title	*Custodian*[a]	*Navy Contact*
Acrylics	SC	Sh
Aniline Formaldehyde	SC	Sh
Cellulose Acetate-Butyrate	SC	Sh
Polydichlorostyrene	SC	Sh
Polystyrene	SC	Sh
Vinyl Chloride-Acetate	SC	Sh
Vinylidene Chloride	SC	Sh
Cellulose Acetate	SC	Sh
Cellulose Nitrate (celluloid or pyroxylin)	SC	Sh
Ethyl Cellulose	SC	Sh
Polyamide	SC	Sh
Cellulose Acetate Sheet	A	...
Methyl Methacrylate Sheet	AF	A

[a] SC, Signal Corps; Sh, Bureau of Ships; AF, Air Force; A, Bureau of Aeronautics.

Neither plastic specifications for specific end item applications such as for Molding-Compounds for Plastic Inhibitors and Thermoplastic Non-Rigid Molded Polyamide Resin for Watch Straps nor specifications for electrical insulating materials such as Resin-Filled Treated Glass-Fiber Electrical Insulating Cloth, Tape, and Cordage and Plastic-Sealer, Electrical Insulating, have been included.

The Army Ordnance Department has current projects for preparation of plastic materials specifications as follows:

Project No.	*Title*
TB4-740C	Cellulose Acetate Molded Shapes, Spec.
-740D	Cellulose Acetate-Butyrate Molded Shapes, Spec.
-740E	Cellulose Acetate Sheets, Rigid, Spec.
-740F	Methacrylate, Molded Shapes, Spec.
-740G	Polyethylene Molded Shapes and Sheets, Spec.
-740H	Vinyl Chloride-Acetate Resin Plastics, Spec.
-740I	Plastic, Melamine-Formaldehyde, Molded Shapes, Spec.
-740J	Plastic, Phenolic, Molded Shapes, Spec.
-470K	Plastic, Cellulose-Nitrate, Sheets, Rods and Tubes, Spec.
-740L	Plastic, Cellulose Propionate, Molded Shapes, Spec.
-740M	Specifications for Miscellaneous Plastics and Related Materials

Coordination of Effort:

While there appears to be considerable amount of duplication among the various groups preparing specifications, in general, the specifications mentioned above do not duplicate each other and combining all the variety of end use applications for each type of plastic material into one specification would be very impracticable.

The Federal specifications cover those types of plastic applications which are considered general or which are not critical in the military sense.

The Military Series of specifications such as JAN-P-13 and JAN-P-14 cover plastic materials intended for use in military applications which are considered critical and in which the predominant important properties are electrical in nature. The Military Series of specifications being prepared by the Army Ordnance Department are intended to cover plastic materials intended for use in military applications which are considered critical, where compatibility with ammunition components is required and in which the predominant important properties are usually mechanical in nature. The other proposed Military specifications for transparent plastic sheet are intended for use in critical military glazing applications.

Conclusion:

In closing, the criticisms, advice, and assistance of industry relative to specification technical requirements, test methods, policy, etc., are both desired and appreciated, for, after all, Government specifications are industry's specifications. In this connection, I think attention should be called to the fact that contacts in these matters will be most fruitful if made in the case of Federal specifications through the Chairman of the Federal Specifications Board Technical Committee, G. M. Kline of the National Bureau of Standards, and in the case of the Military specifications, through the custodian as listed. It is not intended to say that other discussions or contacts should not be held or made.

The author would leave this thought, especially for those who are industry representatives: The plastics technicians in the Federal Government are subject to all the failures of human nature and will, most likely, at times commit themselves to actions which will later be viewed as having been wrong or not of optimum judgment; however, they are as desirous as anyone in the plastics industry of getting out specifications which are technically correct, adequately prepared, and generally acceptable.

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(4) "Modern Shipping and Materials Handling," Am. Management Assn., *Packaging Series No. 17* (1946).

(5) Symposium on Adhesives, Am. Soc. Testing Mats. (1946). (Symposium issued as separate publication, *STP No. 65.*)

(6) W. S. MacLeod, "Twenty-seven Years of Federal Specifications," *Standards World*, Vol. 1, No. 3 (1949).